PROGRESS REPORT

OF THE

ENGINEERS IN CHARGE

TO DEVISE AND PROVIDE A

SYSTEM OF SEWERAGE

FOR THE

City and County of San Francisco

FOR THE

FISCAL YEAR ENDING JUNE 30, 1893

JAMES H. BARRY, PRINTER
429 MONTGOMERY STREET
1893

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SAN FRANCISCO, July 15, 1893.

To the Honorable the Board of Supervisors
Of the City and County of San Francisco—

GENTLEMEN: We submit herewith a progress report covering the work done by the Board of Engineers as finally organized on August 27, 1892, under Resolution No. 6612 (Third Series), and that of the Engineers in Charge to devise and provide a system of sewerage, appointed by Resolution 8294 (Third Series), together with a careful compilation of official street grades in the form of a supplement.

Very respectfully,

MARSDEN MANSON,
C. E. GRUNSKY,
Engineers in Charge to Devise and Provide Sewer System.

TOPOGRAPHICAL FEATURES

OF THE CITY AND COUNTY OF SAN FRANCISCO.

San Francisco is built on the peninsula lying between San Francisco bay and the ocean. It covers the entire northern portion of this peninsula fronting westward upon the Pacific ocean, northward on the ocean, the Golden Gate and the bay, and eastward on the bay. Its southern boundary is an east and west line from ocean to bay, lying about seven miles south from the Golden Gate.

The exterior form of the city may be described as an irregular square with sides nearly conforming to the cardinal directions except that the central portion of its northern front juts out at Fort Point beyond a right line, and that its western and eastern fronts bear somewhat east of south instead of due south.

The spur of the Coast Range mountains, which has its northern terminal at the Golden Gate has no point within the city rising to the dignity of a mountain, although several gracefully-rounded peaks, Las Papas or Twin Peaks and Blue Mountain, near the center of the city, rise to a height of over nine hundred feet.

The peninsula spur of the Coast Range divides the city, as above described, into two main water sheds, of which one sends its drainage toward the ocean, the other toward the bay. The dividing line between these two slopes enters the city limits from the south a little west of a median line, and holds a quite direct course to Fort Point.

The lowest points of this summit are over 200 feet high. The southern division of the Southern Pacific Railroad and the Mission or County Road cross the same south of Twin Peaks; parts of Golden Gate Park and Richmond lie upon the flat top of the summit north of this central group of hills.

The principal spurs from this peninsula backbone subdividing the eastern water-shed are: Hunter's Point ridge, to the south of which lie two small valleys opening toward the bay, of which the southernmost, Visitacion Valley, is partly in San Mateo county; Bernal Heights, between the two branches of Islais Creek; the Potrero hills, which are barely connected with the main ridge by a slight swell in the ground; and the Northern Ridge, terminating in Russian and Telegraph Hills, on the northeastern bay front of the city.

The western water-shed is subdivided by the Point Lobos spur of hills and by the flat-topped Ocean House ridge into three drainage basins, of which the northernmost is tributary to Mountain Lake and Lobos Creek; the second embraces a region of shifting sand dunes extending well up on the western slope of the Twin Peak Hills, and the third sends its waters into Laguna de la Merced

The several spurs of hills which thus establish a number of natural drainage districts, in most cases terminate rather abruptly. The terminal group of hills on the Point Lobos ridge rises to an elevation of 330 feet, one of the highest of these hills being only about 1,000 feet from the shore line; on the Fort Point ridge, about a mile south of the Golden Gate and only a quarter mile from the ocean shore, is a prominent elevation over 400 feet high.

The Presidio Heights, near the point where the Northern Ridge leaves the main ridge, have greatest elevations of 300 to 380 feet.

Lafayette Square rises to a height of 380 feet; Clay Street Hill is 360 feet high; Russian Hill is 370, and Telegraph Hill is over 290 feet high. The lowest point on the spur which extends northwesterly from Russian Hill and terminates at Black Point is about 90 feet high, and Black Point itself is 100 feet high. On the Potrero Hills are points nearly 340 feet high, and on the Hunter's Point ridge several hills rise to over 250 feet. Railroad avenue crosses this ridge at an elevation of 60 feet, and San Bruno Road at 60 feet. The spur extending eastward from the Hunter's Point ridge, near the south line of San Francisco, leaves the main ridge at an elevation of 550 feet. It is crossed by the San Bruno Road at an elevation of 140 feet, and terminates in a hill whose top is nearly 500 feet high.

Bernal Heights rise to an elevation of over 490 feet; Buena Vista Peak is nearly 520, and Lone Mountain nearly 480 feet high.

Between the several ridges or spurs of hills, as above referred to, lie valleys or broad, flat slopes opening out upon the bay or ocean. The basin south of the Point Lobos ridge has no well defined line of drainage. Irregular sand dunes, formed of sand blown eastward from the beach, form a broad, broken slope to the ocean.

The drifting sands have been carried over the main peninsula ridge to the northward of the Twin Peak group of hills, and, separating into two parts, at Lone Mountain, found lodgment in a broad belt extending eastward and southeasterly across the peninsula to Mission bay, and in lesser quantity on the southern slope of the Northern ridge.

The sand from the northern beach westward of Black Point has drifted southeasterly and easterly, piling up great sand dunes to the southward of Black Point in the vicinity of Lobos Park, and terminating on the western slope of Russian Hill and the northern slope of the Northern ridge.

Where sand has thus drifted over portions of the site of the city it covers clays, shales and serpentines. At points where the surface has not been covered with sand a clay soil predominates.

The northern and eastern shore of the city is indented by arms of the bay, which extend well within the ultimate shore line as proposed for the city. As the built-up area of the city is extended these are filled in; but the districts thus reclaimed are low and flat yet in many cases of great extent. That part of the city east of Montgomery and south of Clay street is largely of this character; Mission Bay has been nearly closed against tidal waters, but the extension of the built up area over its surface has not been rapid because there has been ample opportunity for the growth of the city in other directions. Street grades in the Mission Bay district throughout an area of about 150 acres have been established at City Base (City Base being 6.7 feet above an ordinary high tide). Islais Creek, south of the Potrero Hills, opens to the bay through broad mud flats covered to the extent of about 500 acres by the city. As far inland as Fifteenth avenue and San Bruno Road,

about two miles from the water front, street grades have been established as low as one foot below City Base.

South of Hunter's Point an area of seven to eight hundred acres within the city limits extends out into the bay over low mud flats which will some time be filled to about City Base.

On the northern front of the city tidal area and bay surface that will fall within the proposed seawall line aggregate about 270 acres.

It is interesting to note that, although San Francisco is built on hills and undulating ground rising high above the level of the sea, it embraces within its limits several thousand acres of salt marsh and bay surface, portions of which have been filled in and are built upon, but by far the greater portion of which remains to be reclaimed in the ultimate growth of the city.

The area of San Francisco, including the lands already reclaimed and to be reclaimed, estimated to the officially established water front line, is 30,680 acres (about 48 square miles). The area already built upon covers about 8,000 acres, covering almost the entire northeastern quadrant of the city as above described and extending in a long narrow strip several miles westward from the densely populated region, along Point Lobos avenue and neighboring streets; also extending southward along the principal lines of travel, San Bruno Road and Mission Road, with occasional spots, as in the Potrero and South San Francisco, where an aggregation of residences and other buildings marks a nucleus of suburban growth.

The built up or populous part of San Francisco can readily be subdivided into districts of two characters—the one class embracing portions of the city on sloping ground, hill sides and hill tops, at such elevations that they can be readily drained by gravity flow, the other embracing the low, flat districts for which it is difficult or impossible to provide satisfactory drainage without recourse to pumping. But when thus segregated into districts the several districts of each class are not contiguous; their drainage cannot easily be combined, and the solution of the drainage problem is rendered much more complex than if there were only one instead of many drainage basins.

The extent of the several water-sheds for whose drainage provision is to be made may be preliminarily noted as follows:

	Visitacion Valley	990 acres.
	Bay View district	1,220 "
*	Islais Creek district	3,900 "
	Precita Creek district	1,730 "
	Mission Bay district	5,860 "
	Yerba Buena Bay district	430 "
	North Beach district	320 "
	Washerwoman's Bay district	1,030 "
	Presidio district	930 "
	Lobos Creek district	2,120 "
	Ocean Beach district	5,650 "
*	Laguna de la Merced district	3,350 "

Each of these areas covers the entire space from summit to summit of dividing ridges and includes bay or ocean frontage. Being intended for general classification purposes only, a more detailed subdivision is not necessary at this time.

The Islais Creek district should really embrace that of Precita Creek, which is tributary to the former, but as the junction of the two creeks is at the margin of the salt marsh and Bernal Heights between the two, forms a very prominent line of division, they have been enumerated separately.

In the discussion of volumes of flow from the Islais Creek district and from the Laguna de la Merced district, the fact is not to be lost sight of that provision must be made for natural drainage from portions of their water-shed beyond the southern boundary of San Francisco. This is true also, though to a lesser extent, in the case of the Visitacion Valley district.

The problems of drainage for these several districts are distinct for each, but can to a certain degree be combined.

As it is not proposed at this time to discuss these several problems in all their bearings, we shall confine ourselves to such descriptions as are necessary to understand present conditions and facilities for drainage.

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* North of the County line.

ISLAIS CREEK DISTRICT.

There being no sewers in use in Visitacion Valley and Bay View districts, which are sparsely settled regions, we pass at once to the Islais Creek district.

Mission road and San Jose road both lie within this district from points near Holly Park to the County line. The open waterway of Islais Creek is the drainage channel of this district and into this creek a few local sewers deliver their flow.

The creek takes a course through private lands, some of which have not been subdivided into blocks. When they are to be subdivided and streets are to be laid out through them, special attention should be given to the matter of drainage because it will be necessary to so locate the streets that a proper alignment of the sewers will not be interfered with.

Islais Creek receives water from a small portion of the northern slope of San Bruno Mountain, south of San Francisco, from the northeastern slope of the Twin Peak group of hills and from the entire southern slope of the Bernal Heights. It drains a suburban region of considerable importance that is rapidly being built up.

The main creek is formed by the junction of two branches, of which the northern branch descends from the Twin Peak slopes, crosses under San Jose road and the Southern Pacific Railroad track, and meets the southern branch in the depression between San Jose road and the County road. The creek flows thence in a northeasterly direction to the base of the western slope of Bernal Heights; thence gradually opening to a broad expanse of tide marsh sweeps around the southern and eastern base of these hills in a long curve, and, receiving Precita Creek from along the northern base of these hills, terminates in the tidal basin that has been formed by the grading of Kentucky street from the Potrero to South San Francisco.

Islais Creek is by statutory enactment declared to be navigable "from Franconia landing, near Bay View turnpike, to its outlet into the bay of San Francisco, and thence easterly along the southerly line of Tulare street to the City water front on Massachusetts street, of the width of the channel of said creek." Notwithstanding this statute Kentucky street has been filled across the creek and across Tulare street, and the connection of the land-locked tidal basin, west of Kentucky street, with the bay, is confined to a large wooden box culvert under Kentucky street.

This basin is the recipient of the flow of Islais Creek and of Precita Creek, which near its junction with Islais Creek receives the discharge of Army street sewer.

Just above Franconia Landing the Islais Creek tide marsh is crossed by the extension of Fifteenth avenue, the official grade of which has been established at one foot below City Base or only 5.7 feet above ordinary high tide, although, as already stated, this point is about two miles in a direct line from the proposed water front of the city and is one mile and a quarter above or west of Kentucky street. Kentucky street grades across the Islais Creek marsh lands are at City Base. It is very evident therefore that the low grades on Fifteenth avenue and San Bruno road, still further west, where they are fixed at about City Base, were ill-advised and need revision.

The Islais Creek tidal basin will, as population in the water-shed tributary to it increases, be increasing in foulness from year to year, and unless systematic treatment of the drainage from the districts tributary to it is effected, the history of filth accumulation in Mission bay and Channel street will there be repeated. At the point where Mission road crosses Islais Creek, two sewers, one from the northeast along this road and the other from the southwest, discharge through the top of the masonry culvert in which the creek flows under the road embankment. The upper portions of the creek are fouled by refuse from the truck gardens, pig-pens and corrals on its banks and local sewage delivered to it in open ditches or temporary drains.

PRECITA CREEK DISTRICT.

Precita Creek water-shed is separated from the Mission Bay district by a spur from the northeastern slope of Twin Peaks, which has its last prominent eminence at Twenty-first and Sanchez streets, by the Potrero hills and by the gentle swell at the head of the Mission Valley, which turns Precita Creek southward to an outfall between Potrero hills and Bernal Heights into Islais Creek. As a waterway the creek, except throughout the last half mile of its course, has been supplanted by Army-street sewer, but to the north of Army street there is still much low wet marsh ground, some of which is kept foul by the outflow of local sewers, the most notable of which is Potrero avenue sewer, which terminates at Twenty-fifth street.

At the present writing Army street sewer discharges its flow through a break in the side of the sewer just east of San Bruno Road in the Precita Creek channel, whence after spreading out over several acres of the marsh land it reaches the main channel of Islais Creek.

The break in Army street sewer here referred to is in the side of a wooden box which was put in as an extension of the brick sewer that terminates at San Bruno Road. This wooden box has been carried along Army street to Kansas street and thence to Marin street, in which street it terminates at a point about 50 feet east of Kansas street. During the storms of last winter, which caused a settling of the fill on top of this wooden sewer, it was crushed at several points and the accumulation of pressure due to the stoppage of flow was probably the cause of the break near San Bruno Road.

Some temporary relief to existing evils can be afforded in this vicinity by extending the brick sewer several blocks and by carrying a small box sewer with storm water overflow at a suitable point, well out toward the main waterway of Islais Creek; but the planning of a permanent system of outfall work, requiring as it does a revision of grades, will involve much more study than we have yet been able to devote to this district.

MISSION BAY DISTRICT.

From Potrero hills on the south to the Northern ridge on the north, and extending westward to the Twin Peaks, is a drainage basin of large extent, embracing more than 4,000 acres, most of which is densely populated, including as it does the heart of the city, the entire Mission and the entire Western Addition. All the drainage of this region, except small portions intercepted by Brannan street sewer, are discharged into the open waterway of Channel street through the feeders of the Channel street sewer, through Seventh, Sixth, Fifth, Fourth and Third street sewers, and through small sewers in the Potrero. The discharge from these sewers, representing as it does more than one-half of the drainage of the built-up portions of the city, ebbs and flows in Channel street, impregnating the banks of the channel and the mud in its bed, and coating the piles under the wharfs with an indescribable filth. If there were a large tidal area at the head of the open waterway of Channel street there might be some hope of having a part of the filth carried to the bay at each ebb tide, but the tidal area is inadequate, and by reason of the rapid encroachment of street improvements it will soon be obliterated entirely. The situation has been made still worse by the dumping of garbage upon Mission Bay lands, which still continues. The concentration of filth in Mission Bay and Channel street has been a fruitful source of complaint in the past.

Referring to the same subject, in 1874, Henry Gibbons Jr., M. D., in his official report as Health Officer, says: "Washerwoman's Bay, Mission Bay and Mission Creek are constantly augmenting in filthiness. The difficulties in the way of remedying this evil seem almost insurmountable, although effort has been made, and some work has been done in Mission Bay. It is a happy circumstance for our people that this bay is not to the windward of the city. If any one doubt it let him ride over Brannan or Fourth Street Bridge on a warm day when the tide is low. In regard to Mission Creek much might be said. Few seem to know its extent or its filthiness. From away beyond Eighteenth street, where it originates in a pond, down past Sixteenth street, at its intersection with Harrison—the very recollection of which locality by a person who has visited it, is almost sufficient to sicken—to the outlet in Mission Bay and even beyond, it smells to heaven with a loudness and persistence that the strongest nostrils may not withstand, and the disinfectants of a metropolis could not remove. If by any means it were possible to draw sufficient public attention to these serious evils to cause their speedy removal, I would feel that a better work in the interest of the public health had been accomplished than all else combined."

It is only necessary to add to what Dr. Gibbons has so forcibly said that since the above report was made by him Channel street sewer has been constructed to Ninth street, its present termination, and the Mission Creek lands were in large part filled in; but that to the eastward and southeastward of Ninth street the accumulation of filth has been allowed to continue throughout the nineteen years that have intervened, and the discharge of the sewers into the open waterway of Channel street still continue.

The principal sewer of this district is the large Channel street brick sewer, the lower portions of which are constructed in elliptical form, with large diameter placed horizontally. The inside diameters of the sewer are eleven feet and eight and one-half feet respectively. This sewer following closely the former alignment of Mission Creek intercepts the flow of the several sewers which before its construction discharged into the creek, notably Eighteenth street sewer, of which Channel street sewer may be said to be a continuation, Seventeenth, Sixteenth, Fifteenth, Fourteenth and Eleventh street sewers, all of which are elliptical three feet by five feet sewers of the usual type. Of these sewers those on Fourteenth and Fifteenth streets receive the flow from that portion of the Western Addition drained by the Fell street system. Nearly all the rest of the sewage from the Western Addition reaches the Eleventh and Seventh street sewers, of which the former discharges

into Channel street sewer and the latter, crossing Brannan street sewer, has its outfall point in the open waterway of Channel street. Brannan street sewer is connected at its upper end, near Tenth street, with the Channel street sewer, and may be considered a relief outlet of the latter. It is a seven feet circular sewer which intersects the several sewers on Eighth, Seventh, Sixth, Fifth, Fourth and Third streets, and intercepts Ninth street sewer. At Rincon Hill near First and Second streets this sewer was constructed as a tunnel, and its invert is about thirty-eight feet below official street grade at Second street.

The grade of the Brannan street sewer does not conform closely to the elevations of the bottoms of the several sewers which it intersects. These are generally from one to three feet higher than the bottom of the Brannan street sewer, which thus becomes a recipient for the sewage from the entering sections of the sewers. The outgoing sections lying between Brannan and Channel streets may be regarded as relief outlets. As a matter of fact there is generally so much silt and sludge in the Brannan street sewer that the non-conformity of grade is in most cases obliterated and partition of the sewage flow in Brannan street sewer occurs at nearly every street-crossing.

The outfall of Brannan street sewer is under the wharf at First street. During the ebb flow the sewage delivered by it into the bay is crowded inshore under the wharves to the northward by the outflow from Channel street. At flood tides it is carried along shore southward and westward into Channel street.

Aside from the principal drainage lines of the Mission Bay district, there are sewers on Mission, Howard and Folsom streets, each of which has an independent outfall to the bay under the wharves or piers of the water front.

The sewage from the northern slope of the Potrero hills is either dumped on the Mission mud flats by means of small temporary sewers, or reaching the Potrero street sewer it is delivered into the bay near the Union Iron Works.

YERBA BUENA BAY DISTRICT.

That low, flat portion of San Francisco north of Market street and east of Montgomery street, with the slopes of the hills westward to Jones street and northward to the summit of Telegraph Hill, is Yerba Buena Bay district. It is relatively a small district, but it covers the most important business section of the city. This, together with the fact that about 120 acres of this district have been reclaimed from the bay, make the sewerage problem for Yerba Buena Bay district one of particular interest and importance.

It is here, in this old part of the city, that the examples of large intersecting sewers are most striking. San Francisco's Chinatown lies in the center of this district, on the slopes whose sewage and silt contribute to the deposits annually piled up in the many sewers of this district on light gradients.

To describe the present system of drainage it is only necessary to state that every east and west street from Broadway to Sutter has its three feet by five feet brick sewer, and that there is a similar north and south sewer on almost every intersected street, and in the lower part of the district, nearly every alley, court and place has a similar large brick sewer. Until within a few years there was an outlet for the sewage from these sewers at the foot of each east and west street and at the foot of Market street. Now, however, Market street sewer has been extended in the form of a wooden box sewer northward along East street to the foot of Washington street. It intercepts Sacramento and Clay street sewers. Washington and Jackson street sewers are in a similar manner turned southward on East street and are also connected with the Washington street outfall.

As Market street sewer intercepts the several brick sewers of the east and west streets from Geary to Sacramento street, a considerable flow of sewage is concentrated at the Washington street outlet, which is not at the pier head, but at the low-water line under the wharf. Similarly, the sewers in Pacific and Vallejo streets have been turned into Broadway, and there pass through the sea-wall to the low-water line. Many of the sewers in this district are in comparatively good condition. The construction of at least one-half of them has been needless. All of the large sewers in the flat portions of the district contain much slush and filth which cannot, under present conditions, be removed by flushing and which defies the storms of winter.

Utilizing present sewers to the greatest extent possible, particularly for the storm-water flow, it will not be difficult to devise a separate system for sewage only in the flat portion of this district, and with this combined and relatively inexpensive system, and an interception of the sewage flow from higher portions of the district to meet every requirement. The utilization of the present sewers for storm waters will, however, involve a remodeling of many, the reconstruction of others and an abandonment of many of those now on north and south streets. It will also necessitate the construction of one or more intercepting sewers and the introduction of flushing systems and outfall works that will control tidal inflow and prevent deposits or silt in these sewers.

NORTH BEACH DISTRICT.

The North Beach District includes the bay frontage from Telegraph Hill to Black Point, with Russian Hill and Clay street Hill marking western and southern points of its extent. Here, as elsewhere in the city, the sewers have been constructed without system. The district as a whole is favorably situated for thorough drainage, the only difficult portion being the long extent of bay frontage.

At present the principal sewers are those on Larkin, Hyde, Mason and Powell streets, which terminate at the water line of the Bay.

WASHERWOMAN'S BAY DISTRICT.

From the Presidio Heights eastward to Russian Hill and Black Point, the northern slope of the northern ridge is toward that part of San Francisco Bay known as Washerwoman's Bay, which gives the name to this district. Its peculiarity is the steep descent from the ridge at its southern limit and the large extent of the comparatively flat marginal tract, some of which has not yet been reclaimed from the waters of the Bay.

In this district the building area has been extending gradually downward from the hillsides toward the Bay. Sewers for a long series of years terminated in landlocked basins or at the inshore limit of the tidal marsh, and it is only in the last decade that some relief has been afforded by extending some of the prnicipal sewers to the bay shore.

The outfall points of this district at present are at the bay shore on Pierce street, on Steiner street, on Fillmore street under the wharf, and on Webster street.

The sewage of the Steiner street sewer, and to some extent that of the Pierce street, is being utilized during the spring and summer months for the irrigation of Chinese vegetable gardens located near these streets north of Chestnut street.

LOBOS CREEK DISTRICT.

The plateau region northward of Lone Mountain ridge, westward of First avenue and southwestward of the Presidio ridge, is drained by Lobos creek. All of Richmond lies within the watershed of this creek. This watershed, with the ocean frontage from Fort Point to Point Lobos, is included within the limits of the Lobos creek district.

Mountain Lake is a feature of this district. It lies just within the Government Reservation. The natural drainage channel of the district is Lobos creek, a stream of small though perennial flow, yet of sufficient importance to have been made a source of water supply for the city, which is still in use, though the time is at hand for its abandonment.

The only sewers now in this district are those of the Richmond tract and those of the southwestern slope of Presidio Heights. These sewers have no outlets; they terminate in the sand. The Lake street, or main sewer of the Richmond district, has its lower end at Twentieth avenue, and silt and filth have been accumulating in it during the last two years without chance of escape, except by infiltration through the walls of the sewer into the sands in which it is built. Arrangements are now being perfected by the Board of Supervisors, and bids are to be called for at once extending this sewer to an outfall on Baker's Beach.

Another sewer terminates on California street near Fifth avenue, which, like the main from the Richmond district, has no outlet, though receiving sewage from the southwestern slope of Presidio Heights, where population is rapidly increasing.

OCEAN BEACH DISTRICT.

The Ocean Beach District, as its name implies, fronts westward upon the Pacific Ocean. Its extent is southward from the Point Lobos ridge to near Laguna de la Merced. It has no natural drainage lines across the irregularly plied up sand drifts, the only well defined water courses being in its southwestern portions, between the hills of the Twin Peak group.

There are no sewers in this district, but the necessity for devising a plan of sewers for at least portions of it is daily becoming more urgent, as the area just south of Golden Gate Park is being built up, and the building area will no doubt be rapidly extended.

Here, however, as in other parts of the city, surveys should at once be made on the basis of which an intelligent study of grades can be made, and the correct lines of the several main sewers can be determined.

LAGUNA DE LA MERCED DISTRICT.

Of the Laguna de la Merced District but little is to be said at this time. It is at present one of the sources of water supply for this city. It is sparsely settled, and is in no immediate need of improved drainage facilities, except in its northeasterly portions, at and near Lakeview. But its drainage must be taken into consideration in connection with a determination of the methods to be employed in disposing of the sewage from this and the Ocean Beach District.

A considerable portion of the watershed of this district lies south of the county line, and the ultimate plan of disposing of storm water and sewage in this region must make suitable provision for this district, even though it lies beyond the limits of the city.

THE DISPOSAL OF SAN FRANCISCO'S SEWAGE.

In the case of San Francisco, as in every other city, the first question to be answered in connection with the study of drainage problems is: "How shall sewage be disposed of?" To some extent, it is true, the answer to this question depends upon the general topographical features of the district to be drained and upon the difficulties in the way of collecting sewage, but generally it can be answered without regard to special features of the collecting system.

There are but rarely great difficulties to be overcome in concentrating sewage flow at one or more points where it is to be delivered into a recipient or otherwise treated.

As San Francisco is subdivided by its hills and ridges into many districts, and has the bay and ocean to the east, north and west, toward which these several districts send drainage, it is perfectly natural that original points of outfall should have been and are adhered to until increased population, by causing an accumulation of filth in the vicinity of such points of delivery, compels a modification of the system. By thus adhering to original drainage lines, merely extending them as the city was pushed out beyond the original shore lines, this city is gradually being encompassed by a margin of filth deposits.

Separated from large tracts of agricultural lands, as San Francisco lies, the waste matter contained in the city's sewage will probably never be utilized with profit as a fertilizer. There are no large areas suitable for sewage irrigation within easy reach on which to utilize its sewage.

Through the Golden Gate, along the northern part of the city, there is a daily tidal inflow and outflow of enormous magnitude, and there can be no question that when the city has so increased in population, particularly on its eastern slopes, that the volume of sewage is too great to be delivered to the bay in continuous flow at one or more selected points, it will always be possible to concentrate the entire volume of sewage proper for discharge at the most suitable points into the ebb flow.

The necessity for such intermittent discharge which will insure its conveyance far out to sea, and its movement after it has been carried to sea, are matters which we do not intend to discuss at this time, but recognizing the fact that this means of disposal will probably be ultimately adopted, every permanent work now proposed should be so planned that this result can sometime be attained without involving reconstruction of main lines of sewers now necessary.

To correct the evils resulting from a delivery of sewage at the water front, wherever sewers happen to strike the water line, and to determine, if possible, whether there are any points along the front that offered special advantages as outfall points for main sewers, whether such points are to be for permanent or temporary use only, it is necessary to make a special study of the direction of drift along the bay frontage of the city. This is being done on the basis of current observations made by the United States Coast Survey in the years 1871 to 1875, and a series of float observations that were made by us during the spring of this year.

As the project of intercepting the sewers of the Western Addition, together with that from the northeastern slope of the Twin Peak hills, by means of a main sewer along Market street to Kearny, along Kearny through Telegraph Hill in a tunnel, and thence to an outfall at or beyond a pier head near the foot of Powell street, will be one of the first and most important to be fully discussed and is likely to be favorably considered, we have made the Powell street pier head one of the starting points for these float observations. Avisadero Point was selected as the locality which it was thought would offer special advantages for a delivery of the South San Francisco sewage into the bay and here also float experiments to enable a special study of the direction of flow were made. It is desirable to have full information concerning the direction of drift at different stages of the tide at the water front of the Potrero and in Mission Bay, and here also the necessary experiments have been made. The results of this work have not yet been digested, but will form an important

factor in deciding whether any sewage can be discharged into the bay on the eastern front of the city without becoming offensive to sight or smell, and without becoming a menace to health.

With the several districts defined and outfall points selected it will be possible to determine the required capacity of main sewers and to give them the proper location. These features of the drainage problem and a full discussion of the rainfall, of sewage volumes, and kindred matters must be deferred until we can present a comprehensive project.

THE PRESENT SITUATION.

Immediately upon final organization of the Board of Engineers, the investigation of the condition of the sewers now in use in San Francisco was commenced, and records were searched to supplement the results of this investigation, in order to make this data, which is essential as a basis for the work of the Board, available in a comprehensive and readily accessible form. Entering upon this work of collecting and compiling data with reference to the character and condition of sewers now in use, it was at once found that the records could not be relied on to disclose the size or character of the sewer in any particular street. The information concerning sewer gradients was, we may say, entirely lacking, and the information concerning depths of sewers below street grade was so fragmentary and in such unsatisfactory form as to be of no value whatsoever. Moreover, it was at once found that specifications for sewer constructions were, and had been, general in character with no special requirements to fit particular cases, except for a few sewers that were constructed for districts and according to plans specially ordered to be prepared for such districts; that the specifications, whether of the general or of a specific character, were not closely adhered to, and were often grossly violated, and that no record was preserved showing what was actually done, and to what extent a deviation from plans and specifications had (whether rightfully or not) been permitted by the authorities in charge of sewer construction.

It has heretofore been generally required in the specifications that pipe sewers shall have "openings twenty-five feet apart, sufficiently large to receive a six inch pipe." As the subdivision of street frontage in the residence portion of the city is generally into twenty-five foot lots, it is evident that this requirement is intended to insure available openings for house connections twenty-five feet apart on each side of every pipe sewer. Yet, within a year, sewers have been constructed under these specifications with less than one-tenth of the required number of Ys for house connections in place, and others have been accepted as properly constructed, although the openings required were put upon alternate sides of the sewer, making those upon either side fifty feet apart. In no case, however, not even when the specifications were strictly complied with, has a record of the position of the Ys been preserved, and the lack of information as to position of openings for house connections is so indefinite that it has long been customary to disregard their existence entirely and to make house connections by breaking through the sides of the sewers wherever convenient. Under such circumstances it is not surprising that the necessity for the number of openings prescribed by ordinance and required by specifications is not recognized by contractors, and that believing the Ys useless as many as possible are omitted.

The general specifications as handed down by one set of officers to the next during many administrations require that "steps must be placed in each manhole formed of half-inch iron, set well into the brickwork," etc.; yet for years past the manholes have been constructed without steps.

These and other deviations from specifications are and have been very common in connection with sewer construction in San Francisco, and it is pertinent to inquire why they are possible.

No comprehensive sewer and drainage system for San Francisco has ever been made the guide in the matter of sewer construction. We are at this late date charged with devising one. But even if one had been designed, modifications of detail, due to the extension of streets, changes of street grades and other unforeseen conditions would have to be made from time to time.

The duty of preparing the plans and specifications for sewers required from time to time falls to the City and County Surveyor. He prescribes gradients and exercises control over line and grade. The supervision of construction, however, falls to the Superintendent of Streets, whose department is required to compel strict compliance with specifications.

Sewers are constructed either by public or private contract. In case of sewer construction by public contract all proceedings, the calling of bids, the awarding of the contract and the execution of the work are in direct charge of the city officers.

In the case of sewer construction by private contract, the planning and supervising of the work are in charge of city officials, but the authorities are not concerned in the award of the contract, except that before any private sewer construction can be undertaken a permit for the work must be secured from the Superintendent of Streets.

Whether done by public or private contract, the work is to conform to requirements prescribed by ordinance and specifications, and it is the duty of the Superintendent of Streets to know that there are no deviations from such requirements. Whether constructed by public or private contract, all sewers in streets that have been finally accepted as improved streets, must be maintained and kept in repair at public expense.

The original cost of sewers falls upon the property benefited in proportion to amount of benefit and in proportion to street frontage. In the case of all local sewers, the first cost falls on the property fronting upon the streets sewered.

Although it would appear that by reason of being required to furnish plans and specifications for each sewer constructed, the City and County Surveyor is interested in knowing that the plans are carried out and that the specifications are complied with, it seems to have become a well established custom for that office to participate in ordinary sewer work only to the extent of giving the contractor line and grade for his work and of certifying to the fact that the sewer at its manholes, when completed, has a depth below street grade as named in the certificate then issued.

The City and County Surveyor charges fees prescribed by ordinance for his services, and, as he personally bears all the expenses of surveys, it is natural to suppose that he will endeavor to keep his expenses as low as possible. It is not surprising, then, that when information in his office justifies such a course, he issues diagrams to the contractor with instructions to conform to street curbs for line and grade, or to place the sewer at "10 feet below street grades, if connections will allow," furnishing reference points in the latter case from which a skillful contractor establishes his own grade line.

This system of issuing indefinite, unintelligible instructions to contractors, and for the guidance of Superintendents of Streets, prevails to-day, but it is not of recent origin; it has been in vogue throughout many administrations, and has led to innumerable defects in construction that will entail great expense to correct.

To the engineering profession the explanation is due in this connection that the office of City and County Surveyor is an elective one, that party politics can be relied on in San Francisco no more than elsewhere to consider qualifications for office a prerequisite to election, and that the responsibility for all sewer work has fallen partly upon the Surveyor and partly upon the Superintendent of Streets. Without such explanation it would indeed be difficult to account for the persistent lack of endeavor to effect a reform. The system of municipal administration is at fault, more than the individual officers, and better results will be difficult of attainment until the construction of sewers receives intelligent and honest engineering direction and supervision. In this connection Hon. William Alvord, Mayor of San Francisco, in his address when retiring from office, says:* "If the offices of Superintendent of Streets and Surveyor were united, and the Surveyor allowed the same executive aids which the Superintendent now has, receiving only a salary for his duties, it would be possible to prosecute such works as the opening, grading, paving and sewering of streets according to a comprehensive scientific method and at greatly reduced cost to property holders, who are now assessed doubly and trebly by reason of the many mistakes made in detached improvements. The want of able scientific direction in this department is more especially evident in the matter of sewerage. At present short, isolated sewers are often constructed, without outlet and without reference to ultimate connection with the mains forming part of a well studied, comprehensive system, because such a system has not been commenced or planned."

So lax has been the system of administration in this direction that it is safe to say that Superintendents of Streets have, more frequently than even the several City and County Surveyors, been permitted to prescribe the character and size of sewers to be constructed. The work of sewer construction has moreover been carried forward piecemeal, generally a block or a crossing, rarely a few blocks at a time, according to the temper and inclination of the property holders.

The general specifications for sewer construction being the supposed basis of sewer work, and there being no comprehensive scheme of drainage to adhere to, it has been perfectly natural for the official in direct charge of sewer maintenance and sewer cleaning to insist upon carrying out his views, even in the matter of determining what kind of a sewer should be constructed in any block or in any street crossing, though in fact the only qualification that could be claimed as justifying the assuming of such a responsibility was practical experience in street matters, and the intelligence and common sense supposed to be a part of the stock in trade of every city official.

Only when it has seemed advisable to carry out sewer construction as a work of benefit to a district, in which case the City and County Surveyor has had an opportunity of making a special

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* Municipal Reports 1873-74, p. 640.

WALL OF CESSPOOL
AT COR. OF VALLEJO & FRANKLIN
SHOWING
CHARACTER OF WORKMANSHIP.

charge for plans and specifications, does he seem to have been consulted as to general requirements, and not alone as to line and grade.

The specifications for sewer construction, as furnished by the several City and County Surveyors since 1880, have not differed materially from the following, which have been furnished to the Superintendent of Streets by the present Surveyor and which have become a part of public and private contracts for sewer construction, and have rarely been amplified or modified by special requirements:

EXCAVATIONS, ETC.

"The ground along the line of the above described work shall be excavated to the proper depth for the construction of the sewer upon the grade as shown on profiles, or set by the City Engineer. The bottom of the trench to be formed to the exact external shape and dimensions of the sewer, and the trench at the surface to be at least two feet wider than the greatest horizontal diameter of the same. If the soil be of improper nature for a foundation it shall be removed to such depth and width, and in such manner as may be directed by the Superintendent of Streets, and proper material deposited in its place, and all irregularities, however caused, in the bottom of the trench shall be corrected before constructing the sewer.

"Bracing or shoring shall be used when the same may be considered necessary to prevent slipping or caving of the sides of the trench, and in all cases all such timber must be removed in such manner as to prevent slipping of the sides, and none left unless specially ordered by the Superintendent of Streets.

"Should running quicksand or other treacherous ground be encountered the work shall be pushed with the utmost vigor, and carried on day and night should the Superintendent of Streets so require. The excavation shall be kept free from water during the construction of work, and no concrete or other work will be allowed to be laid in water, and all work must be kept free from water until the cement has set.

"When the proposed sewer connects with, takes the place of or intercepts any existing sewer, drain or culvert the contractor will be required to connect such structures with the sewer in such a manner as directed by the City Engineer, and the contractor must also provide for the flow of such sewers and drains interrupted during the progress of the work as directed by the Superintendent of Streets. Under no consideration shall any works be connected by breaking into old work, but the old work must be carefully taken out and the necessary connections properly inserted.

"All materials furnished shall be subject to the approval of the Superintendent of Streets, and all material furnished or work done which in his opinion are not in accordance with these specifications or to his satisfaction shall be immediately removed and other materials furnished or work done which shall conform thereto.

"No tunneling will be allowed except with the permission of the Superintendent of Streets, and only when it is in order to pass some railroad or to prevent interruption to important traffic, and the crossings of all main streets shall be bridged over or made passable in such manner as may be directed by the Superintendent of Streets.

"After the sewer has been built earth or clay, free from rocks, shall be carefully laid in so as not to disturb the work and solidly rammed or watered, and rammed in layers not to exceed nine inches until the work is completely covered to a depth of at least one foot. The trench shall then be filled with earth in layers not exceeding one foot in depth, each layer being rammed or watered and rammed until filling is complete. When the excavation is in rock then the trench shall be excavated to a depth of six inches below the otherwise necessary depth, and refilled to the proper bottom for the sewer with good clean sand, carefully packed, on which the sewer shall be laid.

"The material taken from the trench, if clean and wholesome in the opinion of the Superintendent of Streets, may be used for refilling; otherwise the contractor will be required to fill with proper material furnished at his own expense.

"The contractor shall be required to put the street in the same condition after the work is completed as it was previously, the Superintendent of Streets to be the judge thereof, and all surplus material must be removed within three days after the completion of the work.

"Whenever the sewer or any part thereof is above the surface of the ground it shall be protected by an embankment of earth filling, to be carried up in horizontal layers not over one foot thick and of equal height at all times on both sides of the sewer, said embankments when completed to be not less than two feet above the highest point of the sewer, to have a width on top not less than the greatest external horizontal diameter of the sewer and uniform side slopes.

"No work shall be accepted which may be deficient in any of the requirements of the specifications in consequence of the neglect of any Engineer or Inspector to point out such defect during the construction, and the contractor will be required to make good any imperfect work whenever discovered before the certificate is given.

MORTAR.

"Mortar, whenever used in this work, shall be composed of clean dry sand, mixed in proportion of one part of cement to two parts of sand (these proportions must be measured and not estimated). These must first be thoroughly mixed dry, and then a sufficient quantity of water mixed to just make a rather stiff paste; it must be used inside of an hour after it is mixed, and not at all if once set.

"The cement shall be the best Portland cement, freshly burned and capable of being quickly worked into mortar. All cement must be approved by the Superintendent of Streets before being used on the work, and the contractor shall afford all facilities of inspecting and testing when required either by the Superintendent of Streets or City Engineer. Cement must be thoroughly protected from the weather and ground moisture, and all condemned cement must be immediately removed from the work.

"The mortar must be mixed in tight boxes furnished by the contractor for that purpose. The water must be fresh, clean and free from dirt or sewage. The sand must be clean, sharp, free from loam, vegetable matter, or other dirt, and capable of giving good results with the cement.

MANHOLES.

"Brick manholes shall be built along the line of the sewers at such points as are shown on plans, or as the Superintendent of Streets may direct, and shall conform in form, thickness and other respects to the plans on file in the office of the City Engineer and to the following specifications:

"The brick-work to be carried up to proper crown of the street as directed by the Superintendent of Streets, and to be there built round and true, with an interior diameter of two feet two inches, according to the plans. The joints to be neatly struck and pointed on the inside, and the brick-work plastered on the outside with a half-inch coat of mortar.

"Each manhole must be furnished with a cast-iron coping and cover of good quality, free from defects and similar to those ordinarily furnished, as they must be subject to the approval of the Superintendent of Streets.

CATCH BASINS (Or Cesspools).

"All catch basins are to paved with two courses of brick, the bottom course to be laid solid, and the upper course to be grouted in with cement, the inner surface to be plastered with a good coat of cement mortar, one-quarter of an inch in thickness.

"Each catch basin to be finished with cast-iron coping pans, etc., of best quality—the catch basins to be connected with sewer as shown on plans—the outlet pipe to be ten inches in diameter, the inner end trimmed flush with the face of the brick-work, said trimming to be done before the pipe is laid. The same care must be used in filling round the basins as in other portions of the work. In case the street has not been either paved or macadamized, the mouth of the basins must be securely closed, and must be closed during the construction of the sewer under any considerations.

BRICK-WORK.

"The bricks shall be of the best quality, burned hard entirely through, free from injurious cracks, with true even faces, and must be thoroughly wet by immersion immediately before laying; every brick is required to be laid in full mortar joints on both sides and ends, which for each brick is to be performed by one operation. In no case is a joint to be made by working in mortar after the brick has been laid. Every second course will be laid with a line, and joints between courses shall not exceed half an inch in thickness, and between the rings or shells they shall not be less than half an inch.

"No bats are to be used in the face of the work except for closures, no bat to be of less size than half a brick, and in the backing not more than two to be laid together.

"Centers will not be struck until earth filling is brought to the height of two feet above the highest point of the sewer, and the mortar is sufficiently set; they will then be struck and drawn

with care, without injury to the work. All work to be carefully protected and no wheeling or walking on it will be allowed. Any work injured before the completion of the whole work to be rebuilt by the contractor at his own expense, and all unfinished brick-work to be raked back in courses.

"The inverts and arches at the junctions of lateral connections, manholes, etc., will be built on suitable centers and special shapes, after plans or instructions from the City Engineer. Vitrified salt glazed clay sewer pipes or spurs of the interior diameter of six inches to be worked into the walls of the sewer, twenty-five feet apart, at an angle of about thirty degrees and in the direction of the flow of the current, one end of the spur to be trimmed flush with the inner face of the brick-work, and the other (the bell end) to project at least one foot beyond the outside of the sewer wall, where it will be fitted with a Y branch for double connection. Said spurs will be set at such heights as may be directed by the City Engineer. All connections with lateral sewers, to be made as shown by plans or directed by the City Engineer. The outer end of all spurs and branches to be securely closed with an earthernware cover or brick carefully fitted in.

"The inverts of all brick sewers shall be examined by the City Engineer upon the completion of the lower half of the sewer, and before the upper half has been completed, and the inside surface of the lower arch of the sewer must be coated with a smooth layer of cement mortar, one-quarter of an inch in thickness.

PIPE SEWERS.

"Pipes must be of the best vitrified salt glazed clay, perfectly burned, without warps, cracks or imperfections, and shall be well smoothed and glazed inside and out, with openings twenty-five feet apart, sufficiently large to receive a six-inch pipe. Said openings shall be formed by the use of one length of Y pipe, and in no case shall T pipe be used. These openings to be securely closed with a stopper made to fit tightly, and of the same material as the pipe. The position of these openings to be marked on the surface of the ground in such a manner as the Superintendent of Streets may direct. All special forms or shapes required must be furnished by the contractor without extra charge.

"The sewer to be laid on a bed of good, clean sand, earth or clay, free from rocks, and then the trench to be filled as formerly specified. All connections of any kind whatsoever shall be made on a curve, and in such manner as the City Engineer shall direct. Before being lowered into trench all pipes shall be fitted together on the surface, and marked in that position, so as to insure after laying a uniformity and smoothness along the inside, especially on the lower half.

"During the construction, a bag filled with straw or other such material, the size of the pipe, must be kept in the pipe eight or ten feet behind the work, and drawn forward as the work proceeds, so as to insure the cleanliness of the inside of the pipe and the smoothness of the inside of joints.

"No sewer will be accepted unless it is perfectly clear and clean throughout its entire length, and so that the full diameter may be seen when looking from one manhole to another. Especial attention will be paid to the construction of the sewer with reference to the line and grade, and where a sewer is not connected with any other permanent work, at least ten feet must be left open in order to facilitate such inspection, and must be filled immediately after said inspection.

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GENERAL CONDITIONS.

"All material and workmanship required for all work under these specifications must be of the best quality and furnished by the contractor.

"The entire work to be executed to the true intent and meaning of these specifications, and the drawings on file in the office of the City Engineer, and to the satisfaction of the Superintendent of Streets.

"Should any doubt arise as to the meaning of these specifications or the drawings, the City Engineer shall be the proper officer to interpret the same and any decision by him in such matter shall be final.

"Bidders will estimate by the lineal foot for the sewer and how much for each manhole cover and corner complete, correctly computing and carrying out the aggregate amount for the entire work."

These specifications were in use until quite recently. They have now, conforming to suggestions contained in our letter of May 23, 1893, to the Superintendent of Streets, been slightly modified, so that there is no longer any ambiguity in the matter of distance between Y's.

A clause has also been inserted requiring the sewer to be left exposed its entire length until the City Engineer examines the same.

In all ordinary cases a diagram is issued by the City and County Surveyor, showing for each sewer to be constructed the line of the proposed sewer and the position and elevation of reference points to be used by the builder of the sewer for line and grade. When the sewer has been completed and is offered for acceptance, he issues a certificate which generally sets forth that at certain points (usually at manholes only) the sewer is at certain depths below street grade.

According to the law governing the matter of street improvements, the City Engineer, when required to do so, must furnish plans, specifications and estimates of the cost and expenses of any contemplated improvement, and for the work of constructing sewers specifications must always be furnished by him. But he does not seem to be required to know that the specifications are really being carried out, except when sewers are paid for by an issue of bonds or out of the Street Contingent Fund. In all other cases the law provides that the work must be done under the direction and to the satisfaction of the Superintendent of Streets.

The law was undoubtedly intended to enable and to require the several departments of the municipal government to enforce strict compliance with plans and specifications, and when an inspector of work is not competent to certify to the construction of work on prescribed lines and to prescribed grades, it would seem natural that the Superintendent of Streets should require some evidence from the City and County Surveyor with reference to correctness of line and grade. But even when thus tested by the Surveyor, a lack of conformity to line and grade at the points where tested does not always seem to have been considered sufficient cause for withholding certificates of acceptance, although in justice to the Surveyor's office it must be stated that the facts, as determined at the few points where tested, have probably always been correctly set forth in his certificate, and special attention has occasionally been called to a lack of conformity by a diagram on the reverse side of the certificate. It is well known, however, that the possession of the certificate, even when not certifying to the correctness of the work performed, has often aided in securing its final acceptance. It must also be evident that under careless or dishonest inspection, by the representatives of the Street Department, sewers can be constructed of proper character and at proper depth at the manholes where they remain open to inspection, and yet be out of line, at improper grade and faultily constructed at other points. This can best be illustrated by reference to an example which in connection with our investigations has come to notice.

On the 31st day of December, 1891, a permit was issued for the construction of a sewer in Baker street between Pacific avenue and Jackson street. The contractor had already entered into a contract with the property owners to construct a fourteen-inch sewer, and this contract, dated April 4, 1891, was the basis of his subsequent work. The diagram issued to the contractor instructing him concerning line and grade is not available, no copy of the same being preserved in any records, but it bore the usual legend, "sewer to be ten feet deep, if connection will allow." The certificate of the City and County Surveyor, dated the 24th day of March, 1892, contains the following: "I have examined the work, grading, wooden and stone curbs, macadam and sewer, Baker street from Jackson to Pacific streets, and find work to official lines and grade (except as shown by diagram on back of this certificate); average crown of macadam 19 inches above official grade, curb and manhole 20 feet 6 inches south of Pacific avenue 9½ inches above grade, depth 6 feet 6 inches below curb of manhole."

On the basis of this certificate and the oath of the inspector, that "the work of constructing a 14-inch ironstone-pipe sewer, with manhole and cover, on Baker street between Pacific avenue and Jackson street, has been completed in a good and workmanlike manner and strictly in accordance with the specifications contained in and annexed to the contract under which same has been constructed," the sewer was accepted as a 16-inch sewer on March 25, 1892, and the work was paid for by the property owners.

By our orders portions of this sewer were uncovered in May, 1893, and there might just as well have been no sewer in place. At some points it was only between 2 and 3 feet below official street grade and only 3 to 4 feet below the present crown of the macadamized street surface, and did not average 4 feet below street grade. Its gradient was so irregular that on the convex surface of the pipe at some joints between pipe sections the spigot end of the one did not reach the outer edge of the bell of the next by half an inch to an inch. The joints between sections were not filled with mortar, and rarely showed signs of mortar except at the bottom and on top. As usual with the

VIEW OF INTERIOR OF PACIFIC ST. SEWER
LOOKING UP FROM A POINT ABOUT TEN FEET EAST
OF THE EASTLINE OF FRONT ST.
THE SEWER GRADE RISES 29 INCHES
AND THE TOP OF THE SEWER IN THE CROSSING PARTLY CLOSE THE UPPER
15 SEEN BELOW THE BOARDS WHICH CLOSE THE EAST LINE OF FRONT ST.
HALF OF THE SEWER WEST OF THE EAST LINE OF FRONT ST.

sewers of the city, only one-tenth of the prescribed number of openings for house connections were in place, and there was no ladder in the manhole.

(When the fact that we were uncovering this sewer came to the notice of the contractor who had done the work, he at once volunteered to put the sewer in properly, and we believe this has been done.)

Another recent example of the evil results of divided responsibility and lack of definite instructions was found at Randall and Chenery streets. At the crossing of these streets there was no connection of the sewers in the adjacent streets with the sewers in the crossing. They were built at different depths below street grade. We venture no explanation. The Street Department has been at work at this point this year making necessary alterations.

At the crossing of Elizabeth and Ellen streets the official grade is 236 feet. This means that the sidewalk curb at each of the four corners should be at this elevation. Both streets near this crossing are graded and have been macadamized. Redwood curbs have been set, but not to official grade, on the west side of the crossing. The northwest curb is about 3 feet too high; the southwest curb is about 1.7 feet too high. The sewer in Elizabeth street west of this crossing is only 4.8 feet below the present curb lines and only 2.6 feet below official street grade. In seeking information concerning the reason for this peculiar condition of affairs we have been told that at the time the work on these streets was done a grade change was petitioned for by property owners, and that the work done was intended to conform to the proposed change. How it happened that work for whose maintenance the city will hereafter be responsible, as in the case of the sewer, was permitted to be constructed to a proposed grade instead of to official grade finds its answer in the system of street administration.

Some twelve years ago the three feet by five feet brick sewer in Pacific street east of Battery street was constructed to the prescribed depth, which may have been "ten feet, if connections will allow," although its bottom at Battery street was thereby made two feet and a half higher than the bottom of the Pacific street sewer for which it was to serve as an outlet. It is very improbable that such a connection was planned by the authorities. It may safely be assumed to be due to indefinite instructions issued to the builder.

On the 10th day of June, 1893, a diagram was issued to a contracting firm as a guide to the construction of a sewer in Seventh street from Townsend to Channel. This diagram indicated the position and elevation of a number of reference points, and the only instruction given the contractors concerning grade throughout the three blocks covered by the contract was in the following words: "Sewer to be ten feet below street grade if connections will allow," which appeared on the diagram.

The sewer to be constructed was intended to replace a wooden box sewer which had served its time, and is an extension of the three feet by five feet brick sewer that was already in place in Seventh street above Townsend street. The bottom of this brick sewer at the north line of Townsend street is more than eleven feet below street grade, but of this fact the contractors had no information at the outset; neither were they informed of any special connections to be made with existing sewers, or sewers that might hereafter be proposed. Moreover, it was apparently made optional with the contractors if connections required a less depth at any point, to put the sewer at a less depth, and to fix their own grade line. No matter what was intended by the instructions furnished on the diagram by the City and County Surveyor, it is patent that if the sewer at Townsend street must be at a greater depth than ten feet below street grade, it may have to be at a greater depth throughout Channel street.

The contractors can hardly be assumed to have incurred any responsibility by reason of these indefinite instructions, particularly as they were not required to make any special investigations as to depth of existing sewers before commencing the new work. It happened to suit their convenience to commence sewer construction near the lower end of Seventh street, and the new sewer was put at ten feet below reference points set by the Surveyor for street grades. When about to make connection with the old brick sewer in this street at Townsend it was discovered that the new work did not meet the old, being twenty inches higher.

This result is bad enough, but if the instructions are carefully examined it will be seen that even should they mean exactly ten feet below street grades they do not define a proper gradient for a sewer. A uniform depth thus prescribed means a perfectly horizontal sewer at every street crossing, an absurdity which seems to have been early introduced in this city and adhered to with unaccountable persistency.

To the several examples which have already been cited of defective work we have to add another of a main sewer which was constructed under joint supervision of the City and County Surveyor and the Superintendent of Streets. We refer to the Fell street sewer, which was con-

structed in 1891 and 1892, from Cole street, on Fell, along Fell to Scott, thence to Waller, thence to Fillmore, thence to Ridley, thence to Church, thence to Fourteenth, thence to Guerrero, and included a sewer on Oak street from Devisadero to Scott streets, and on Dolores from Fourteenth to Fifteenth streets.

Without entering into detail concerning evidences of careless workmanship, that became apparent by an inspection of the interior, we here present only the result of our investigations at four different points,* selected at random, at which we had the sewer uncovered, in order to dispel or confirm the suspicions that the work was not only defective in workmanship, but was fraudulent.

This sewer was examined in June, 1893, at a point just west of Ashbury street No concrete support was found at that point under the two ring masonry work; neither was a third ring of brick in place. But the specifications require the former, in case of an unstable foundation, and the latter, in case the sewer has a stable foundation.

At another point on Fell street, east of Lyon, a layer of concrete two to six inches in thickness was found interposed between the double plank support and the masonry, but the thin edges of this concrete afforded no support to the sides of the invert as intended by the plans.

The examination at a point on Scott street north of Oak showed a similar deficiency of concrete, and also a fourth on Waller between Steiner and Pierce. In the latter case the outside ring of brick work in the arch was without any support at the sides.

On the diagrams presented herewith the extent of the work in place is indicated in full lines. The work required by the specifications and plans is shown in dotted lines. Further comment on the defects which are apparent at all four points would be superfluous. But we feel called upon to emphasize again the necessity for a modification of an administrative and executive system controlling the construction of public works that permits the acceptance of work which is in clear violation of the requirements.

COST OF SEWERS NOW IN USE.

The following table has been compiled from the published reports of the office of Superintendent of Streets from 1859 to 1892. Where data was lacking approximations were noted. Where marked by an asterisk (*) the approximation was made by this office.

The cost of sewers as carried into this table, though based on estimates made annually, must be regarded as a mere approximation. It includes the cost of improving street corners in some instances, while in others this cost is omitted. When sewers were reconstructed or replaced by new sewers, the length and cost of the rebuilt sewers seem to have been carried into all the records the same as new work.

The aggregate length of all sewers now in use will therefore fall far short of the aggregate lengths noted in the table.

Since 1883 the cost of manholes and the cost of catch-basins (cesspools) are noted as separate items in the official reports, but in the case of catch-basins their cost is generally given in connection with the improvements of street crossings or corners, and the labor of now attempting a complete segregation did not seem justified, particularly as the rates adopted by the several Superintendents of Streets in estimating the cost of different kinds of sewers have varied greatly.

According to the data contained in the table the aggregate length of all kinds of sewers constructed to June 30, 1892, including the length of rebuilt sewers, is 1,322,735 feet, or 250 2735-5280 miles; and the total expenditure for sewer construction has aggregated about $5,714,225.00.

*These excavations were made at the direction of the Grand Jury, to whom the results of our examination have already been presented.

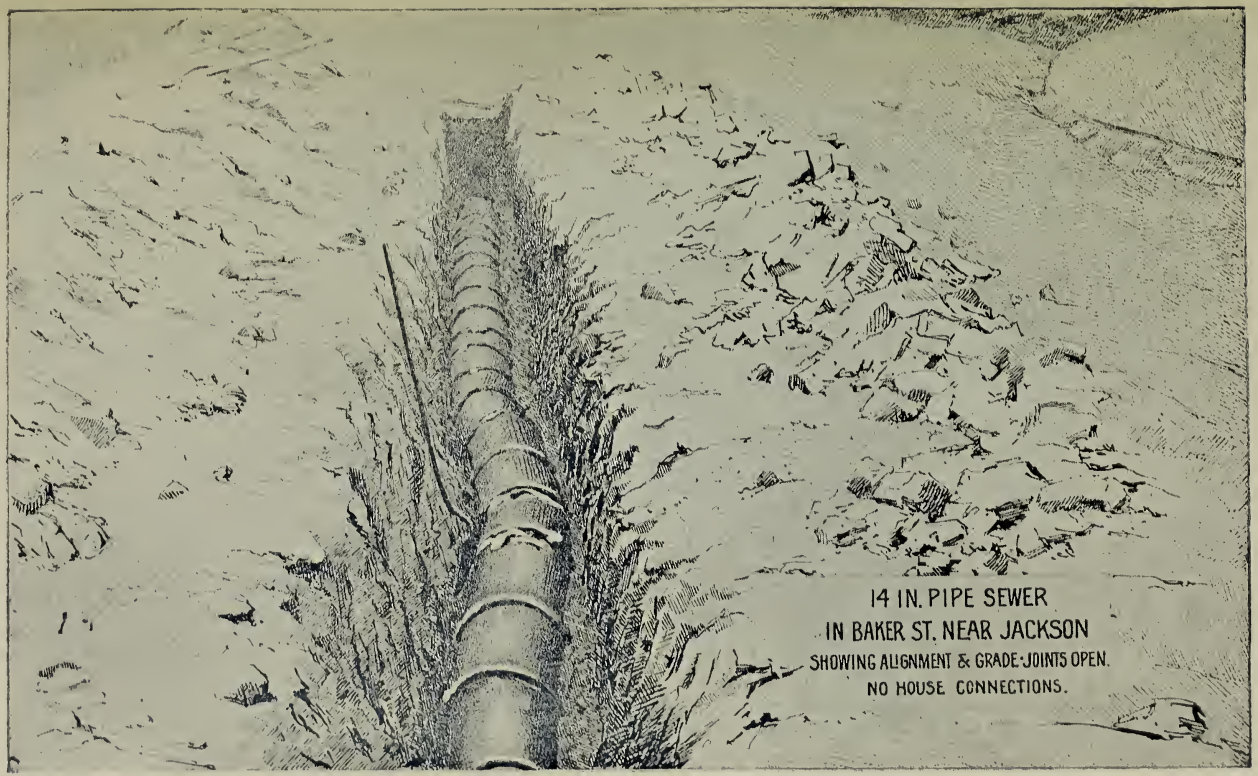
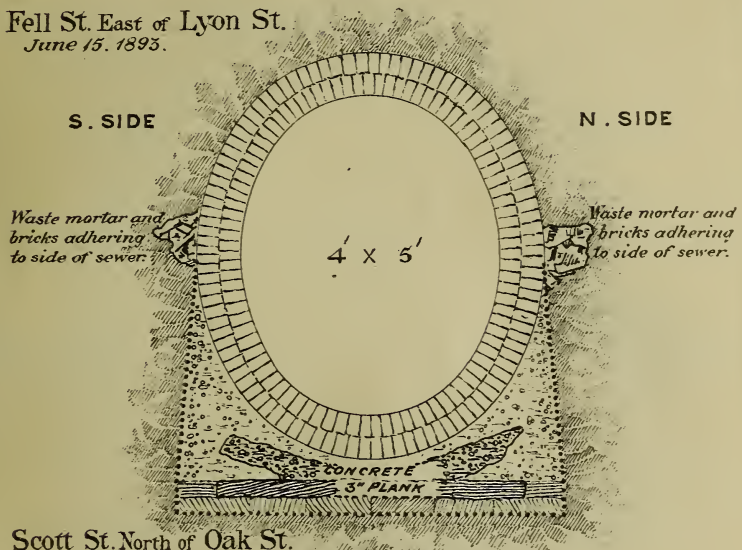

14 IN. PIPE SEWER
IN BAKER ST. NEAR JACKSON
SHOWING ALIGNMENT & GRADE-JOINTS OPEN.
NO HOUSE CONNECTIONS.

DIAGRAM showing

CROSS SECTIONS of SEWERS

The dotted out-line and light shading within show construction called for by specification, viz: concrete foundation upon two layers of three inch plank, the heavy lines and shading show what was found by examination.

Fell St. East of Lyon St.
June 15. 1893.


S. SIDE
N. SIDE
Waste mortar and bricks adhering to side of sewer.
Waste mortar and bricks adhering to side of sewer.
4′ x 5′
CONCRETE
3" PLANK

Scott St. North of Oak St.
June 15. 1893.

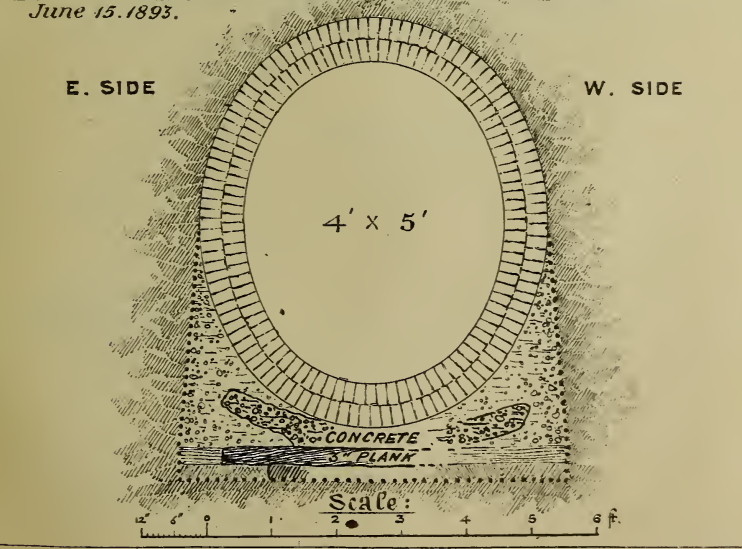
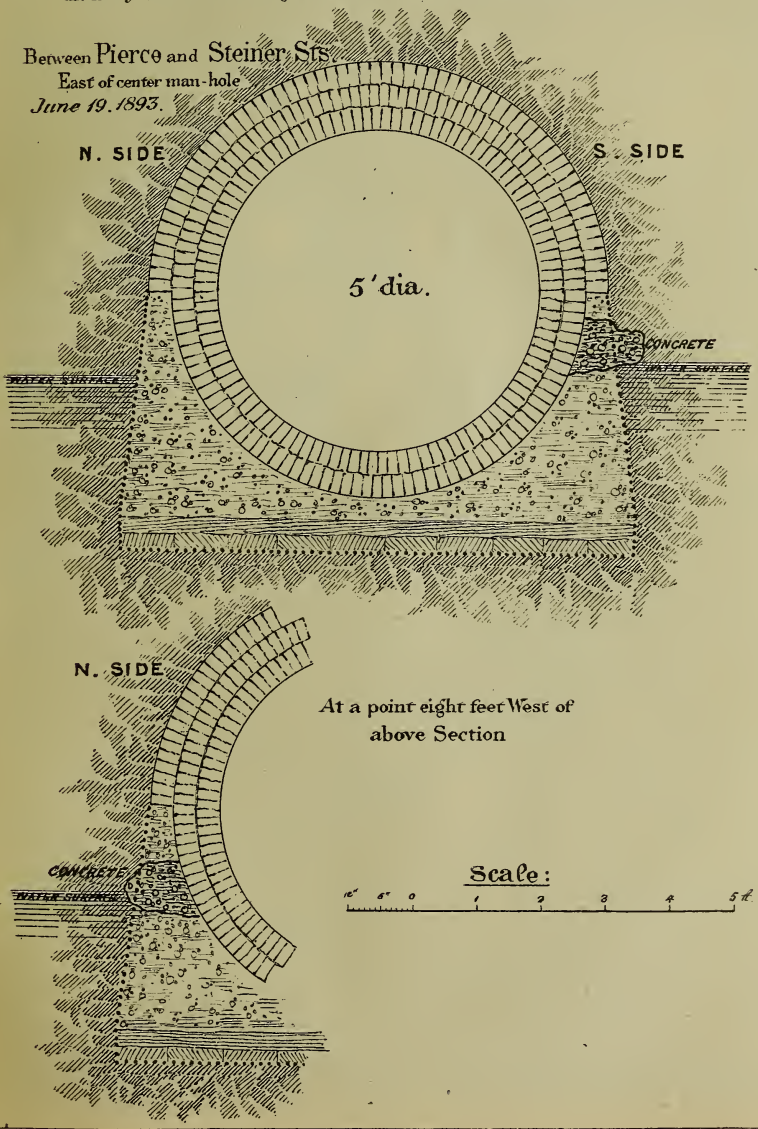
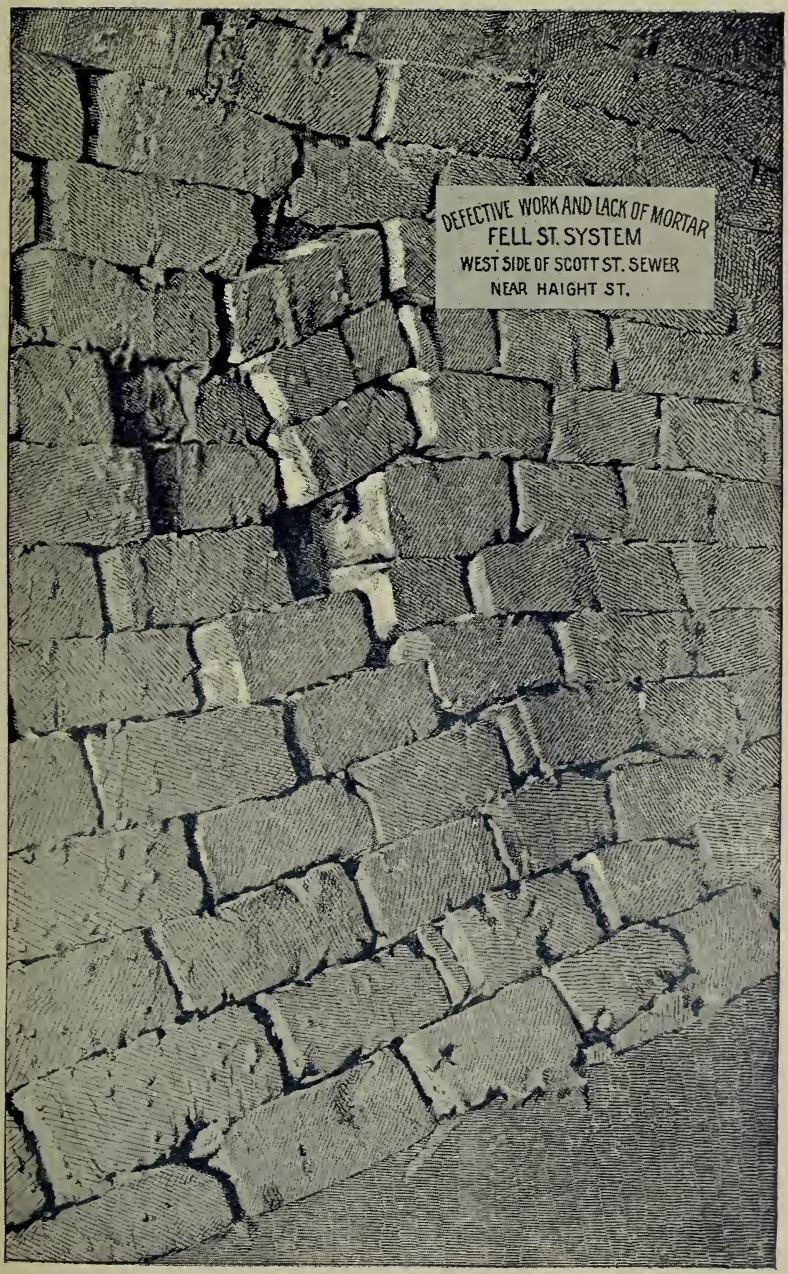


DIAGRAM showing
CROSS SECTIONS of WALLER ST. SEWER

The dotted out-line and light shading within show construction called for by specification, viz: concrete foundation upon two layers of three inch plank; the heavy lines and shading show what was found by examination.




DEFECTIVE WORK AND LACK OF MORTAR
FELL ST. SYSTEM
WEST SIDE OF SCOTT ST. SEWER
NEAR HAIGHT ST.

Year.	Redwood Sewers.		Brick Sewers.		Cement Pipe Sewers.		Iron Stone Pipe Sewers.		Manholes.	
	Length. Feet.	Cost.	Length. Feet.	Cost.	Length. Feet.	Cost.	Length. Feet.	Cost.	No.	Cost.
1858-59...	1,740	$670	*900	$4,883						
1859-60...	.....	3,398	*4,198	22,633						
1860-61...	*760	1,897	*5,725	30,830						
1861-62...	1,606	4,882	10,308	61,916						
1862-63...	5,889	21,649	13,344	116,709						
1863-64...	7,646	27,975	20,012	173,389						
1864-65...	5,272	†29,060	20,967	†287,200						
1865-66...	9,260	39,068	24,414	203,920						
1866-67...	12,137	49,578	21,303	156,745						
1867-68...	11,150	47,424	30,650	237,798						
1868-69...	11,908	50,098	36,630	365,598						
1869-70...	8,695	53,530	23,144	213,481						
1870-71...	1,320	5,468	11,147	62,215						
1871-72...	6,496	17,534	1,648	8,798	6,534	$11,165				
1872-73...	2,561	6,063	10,998	59,316	5,139	11,454				
1873-74...	2,362	8,903	15,921	84,389	4,866	10,373				
1874-75...	5,135	11,415	28,401	162,437	9,321	21,052				
1875-76...	6,140	*14,359	46,564	256,198	16,454	36,821	9,598	$21,864		
1876-77...	8,270	26,954	46,330	346,785	24,492	64,431	24,035	59,654		
1877-78...	3,300	6,707	16,223	100,417	9,261	18,081	21,928	47,826		
1878-79...	2,949	5,900	8,071	42,233	2,949	5,900	11,400	21,841		
1879-80...	1,550	3,098	9,465	49,552	2,201	4,631	8,694	20,462		
1880-81...	420	‡ 1,260	413	2,168	.....	.....	8,278	* 19,870		
1881-82...	.....	.....	550	2,387	1,086	*2,172	1,552	* 3,725		
1882-83...	.....	.....	1,414	7,424	275	*550	4,237	* 10,170		
1883-84...	470	1,642	7,193	41,717	275	*550	12,966	27,229	63	$2,520
1884-85...	1,724	6,410	14,183	89,765	.....	.....	27,135	61,459	134	3,350
1885-86...	481	1,924	10,850	59,675	.....	.....	38,364	86,319	166	4,150
1886-87...	316	1,106	6,244	34,342	.....	.....	27,495	68,737	113	4,520
1887-88...	.....	.....	12,039	66,215	.....	.....	63,849	159,623	225	7,875
1888-89...	.....	.....	2,062	11.341	.....	.....	72,457	144,914	303	10,605
1889-90...	.....	.....	10 813	54,090	.....	.....	77,183	154,366	372	13,120
1890-91...	.....	.....	12,503	62,815	.....	.....	103,136	195,959	351	14,040
1891-92...	.....	.....	37,301	266,824	.....	.....	85,955	154,719	380	13,300
	119,557	$443,063	521,883	$3,746,705	82,853	$187.240	598,442	$1,258,727	.....	$73,480

* New sewers, $4,588; rebuilt sewers, $9,771.

† George Cofran, Superintendent of Streets in 1864-65, says: (M. R. 64-65.) "The cost of work for the past year appears to be enormous, but the calculations are made upon the basis of legal

THE LOCAL SEWERS.

Although we shall at this time speak only in general terms of the system or systems of sewerage which we propose to recommend for this city, a few words are necessary to emphasize the importance of making many local modifications or alterations in sewers, for the improvement of sanitary conditions.

Evils which are out of sight though creating nuisances of the worst kind exist in the sewers of all parts of the city, due to the defective planning and bad constructive work of the past.

Local defects in sewers may be classed under two heads—defects of design and defects of construction. To the former belong excessive size, brick sewer crossings where none were necessary, improper gradients, a superfluity of catch-basins, etc.; to the latter, the use of inferior material, careless workmanship and noncompliance with specifications. These matters have been forced upon our attention in collecting information that would enable us to make intelligent use of the sewers already constructed. Having been brought to our notice they cannot be ignored, and we recognize that the earliest possible provision must be made for abating those which most seriously menace the health of the public. Some reference to them may therefore be permitted in this progress report.

Very soon after the organization of the Board of Engineers, whose successors we are, the following letter was sent to the Hon. Board of Supervisors:

To the Honorable the Board of Supervisors

Of the City and County of San Francisco—

GENTLEMEN: At the outset of our investigations we find that a practice has long been prevalent of constructing brick sewer crossings where none are necessary, and of making many lateral sewers of much larger dimensions than actually required.

Lateral sewers of excessive size are not only more costly in construction and maintenance than properly proportioned sewers would be, but are detrimental to health by reason of the difficulty of properly flushing them.

Should your Honorable Board so desire, this Board will be pleased to advise in these matters and to pass on any project, plans or specifications, which may be referred to us, to the end that more systematic and economical work may be at once inaugurated.

The suggestion contained in the letter was at once acted upon and a resolution was passed, containing the following:

RESOLUTION NO. 7481 (THIRD SERIES.)

"RESOLVED, That the Superintendent of Streets be and is hereby requested, before recommending the construction of sewers to this Board, to first submit the proposed sewer work and the location of same to the Board of Engineers appointed to devise and provide a system of sewerage, for their opinion and approval.

"First—As to the necessity of the proposed sewer.

"Second—As to the required inside diameter or other dimensions of the sewer, its grade and equired depth.

"Third—As to the material to be used in constructing the sewer.

"FURTHER RESOLVED, That the City Surveyor be and is hereby requested to consult with the said Board of Engineers in the preparation of specifications for sewer work, so that the same may be constructed in a manner to harmonize with the plans to be hereafter adopted to provide for a proper system of sewerage."

The letter above quoted is self-explanatory. The absurd practice of constructing large brick sewers in street crossings has extended into all parts of the city.

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tender notes, and as a large portion of the work was done during the autumn and winter months when these notes commanded but little more than forty-five cents on the dollar, the cost in gold would be reduced one-half."

‡ $10,241 expended in repairing sewers this year not included.

As a result of this practice and the construction of sewers in detached sections, a block or a crossing at a time, several distinctive types of sewer crossings have resulted, which it will be necessary to describe somewhat in detail.

In the first place, all sewers in level street crossings are level from end to end, or very nearly level, no matter at what gradients the respective streets approach the crossing. This is a fruitful source of trouble, because at the points where gradients suddenly change regular flow is interfered with; deposits result in the level stretches, which often remain for long periods, and sometimes can only be entirely removed by flushing, and immediately after removal begin to reaccumulate. This applies to intersecting brick sewers as well as to intersecting pipe sewers when no brick sewer intervenes between them and the manhole at the center of the street crossing.

A recent favorite type of crossing, sometimes referred to as the "Bobtail" crossing, has a manhole and brick sewer seveuteen feet long, supposed to be in the direction of main drainage, with which the several incoming and outgoing pipe-sewers are connected.

The sewers in all four directions are almost invariably connected in the street center and the connection is intended to be at grade, and this arrangement prevails even in cases when there is a down grade in the sewers in three directions from a crossing.

In crossings of the "Bobtail" type, sewers are generally at the intended grade, but the section of brick sewer serves no purpose that would not be fulfilled better by a manhole of proper diameter.

But conforming to the law and the requirement that a brick sewer must be constructed in a street before final acceptance of that street, which was in force until 1870, another type of sewer crossing preceded the "Bobtail" and has found introduction in many localities where it can serve no useful purpose whatsoever. This is the full brick crossing. Two three feet by five feet brick sewers intersect each other at right angles in the center of the street crossing, at which point a manhole is provided, resting on top of the masonry.

These sewers from side to side of each street are practically level, and usually ten feet below street grade. These sewers are either continuations of the brick sewers of the intersecting streets or they connect with pipe sewers. Very frequently they are below the grade of the sewers upon either side and become cesspools, with a few inches to several feet in depth of the foulest imaginable putrescent filth, emittiug poisonous gases.

Some times they are on top of a ridge whence streets fall in three directions, and even when drained to the bottom, sewage may go in one direction only, and two of the three wings, leading to descending sewers, are nothing but disease breeders. Such is the one at the crossing of Powell and California streets, where the sewers in two directions are unnecessary and the other two wings ought to be pipe sewers on grade. Such, also, the one at the intersection of Jones street and Golden Gate avenue, whence large brick sewers (three by five feet) carry the sewage to the north, east and south that arrives in very small quantity in a small cement pipe sewer, one block long, from the west. Some times there are three entering and one outgoing sewers, as in the case of Van Ness avenue and California street sewer, where, however, the outgoing pipe, eastward along California street, cannot drain the cross channels of filth to within fourteen inches of the bottom, because it is not low enough; or as in the case of Fillmore and California streets, where the brick sewer crossing is a filth receptacle (more dangerous to health than any old-time cesspool) which cannot be drained to within thirty inches of its bottom.

Special mention of particular cases has here been made merely to illustrate some of the types of abortive design; it is hardly necessary to add that our examination has extended to every part of the sewers in the city that were accessible, and that a complete record in detail of such examination is being prepared that will be of service not alone in devising a comprehensive system but also as a guide to the early correction of the worst evils.

It may perhaps be well in this connection to further illustrate the inexcusable practice of constructing large brick sewers, where very small pipe sewers would have served the purpose.

Main lines of drainage have always been maintained on each of the several east and west streets in the lower part of the city, as, for example, in the district south of Jackson street and east of Kearny street. There are three feet by five feet brick sewers in each of the east and west streets. It might be expected, then, that in the north and south streets there would be only small local sewers; but this is not the case. Every north and south street, every intermediate street or alley, almost without exception, has its large three by five brick sewer. These sewers form a great rectangle of intersecting filth receivers on light grades that cannot be flushed out and cannot be kept clean.

Occasionally an attempt has been made to control the direction of the sewage flow by the introduction of a different arrangement at street crossings from those already referred to. Thus, at Leavenworth and Bush streets, the brick sewer from the north in Leavenworth street turns eastward into Bush street on a curve; but descending toward the south on Leavenworth street and toward the west on Bush street, with dead ends at the crossing, are three feet by five feet brick sewers. Why they are there, unless it be that property is valuable in that vicinity and could afford to pay for an expensive sewer, it will be difficult to explain.

It is recognized as necessary that sewers should be well ventilated, but it is hardly likely that the property owners and residents on any street frontage would consent to have ten-inch ventilating tubes terminating at the sidewalk curb line, when such a pipe leads up from a typical crossing that has been made a cesspool by reason of defective design or improper construction. Yet, in the heart of the city, in the district extending from Hayes street on the south to Washington street on the north, from Mason on the east to Broderick street on the west, there are no less than 139 storm water inlets and catch-basins (cesspools as they are locally, though improperly, termed), that hav been put in at corners from which the gutters slope downward in both directions, which therefore receive no water, not even in the rainy season, and which are never trapped against the contaminating sewer gases.

The construction of the vast number of perfectly useless catch-basins, which the above statement indicates as existing throughout the city, has served no purpose whatsoever, except to yield a profit on construction and to contaminate and threaten the healthfulness of the city.

In the district above named the blocks are 275 feet by 412½ feet. No inconvenience would result to the public if on the grades there prevailing storm water inlets were further apart than one at the foot of the slope of each block. Had this fact been taken into consideration the number of catch-basins would have been still further reduced than by the mere omission of those that are perfectly useless. In the diagram herewith submitted the location of the catch-basins now in use in this district is shown, and those that are useless and those that are unnecessary are specially marked for identification.

Estimated at $90 per catch-basin completely equipped and connected with the sewer, it will be found that the useless catch-basins alone in this small district, which covers only about one-fifth of the entire area of built up portions of the city, have cost the property-owners about $12,500, which sum is to be considered as expended to the detriment, and not in the interest of the healthfulness of the city.

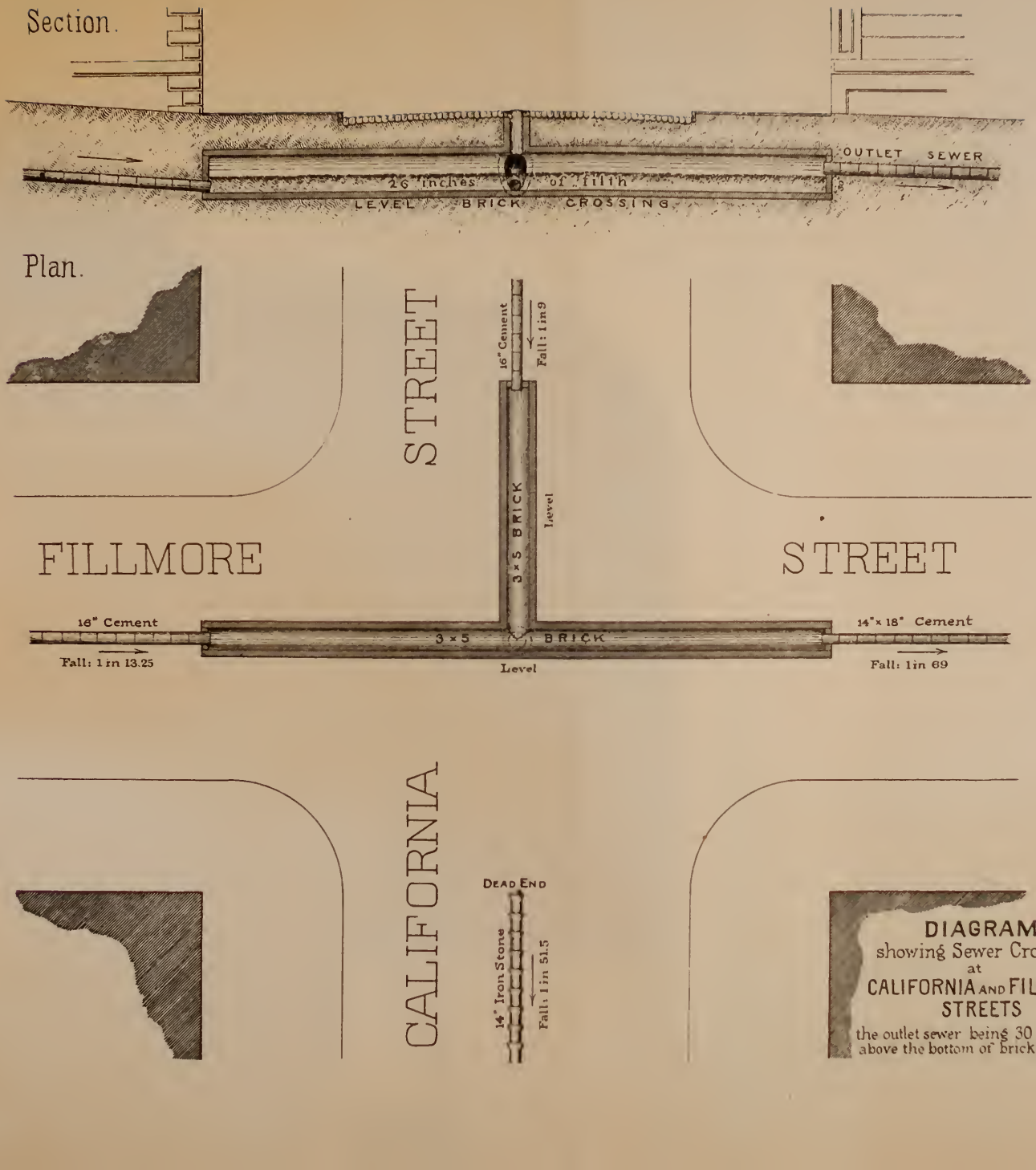
Every storm water inlet and catch-basin is generally supposed to be closed to the sewer by means of a water trap. Most of them are constructed of such form that while in use very little sewer gas can escape from them, but this is by no means true of all. In the most common type a masonry partition wall extends from the top into the basin between the inlet and the outlet, to a depth below the level of the outlet. This partition is supported by an iron bar, and no water can flow from the catch-basin into the main sewer until the water level in the basin rises above the bottom of the partition wall, thus preventing a passage of sewer gas from that portion of the basin on the outlet side to that into which the inlet discharges.

This arrangement is clearly illustrated by drawings accompanying this report.

It is apparent that at the time when it is most desirable to have these storm water inlets trapped against the sewer gases in the summer and fall months, that the probability of their being imperfectly trapped is greatest, because there are no summer or fall rains to fill them. They lose water rapidly by leakage and evaporation, and it is rare that sufficient water is used on sidewalks and streets to replenish the loss. They cannot, therefore, even when in good condition, be classed as reliable traps. Not only are they unreliable when in good condition, but they are frequently out of order. Large amounts of silt collecting in the bottom of the basins sometimes close the passage under the partition wall. During rains streets are flooded until some one raises the outer cover. When such an accident has happened a few times in any locality the idea occurs to some one to break a hole through the partition wall near the top, and there is no more trouble from choking up, but the trap has been completely sacrificed. Hundreds of catch-basins are in this condition. This being the case, the next step taken was the adoption of a simplified catch-basin in which there was no partition wall. As a last step to afford more open way to entering waters, gratings have at many points in the city, notably near the City Hall and on Market street, been substituted for the outer covers, and thus all semblance to a water trap, even though the partition wall be in place, is destroyed.

The question at once arises, are the large catch-basins in combination with the storm water inlets of any service? Should the fact that they are nearly always full to the outlet with silt be made the criterion, the answer must be in favor of these or still larger catch-basins, but before a final

NORTH


Section.
OUTLET SEWER
26 inches of filth
LEVEL BRICK CROSSING
Plan.
STREET
16" Cement
Fall: 1 in 9
3 x 5 BRICK
Level
FILLMORE
STREET
NORTH
SOUTH
16" Cement
Fall: 1 in 13.25
3 x 5 BRICK
Level
14" x 18" Cement
Fall: 1 in 69
CALIFORNIA
DEAD END
14" Iron Stone
Fall: 1 in 51.5
DIAGRAM
showing Sewer Crossing
at
CALIFORNIA AND FILLMORE
STREETS
the outlet sewer being 30 inches
above the bottom of brick sewer.

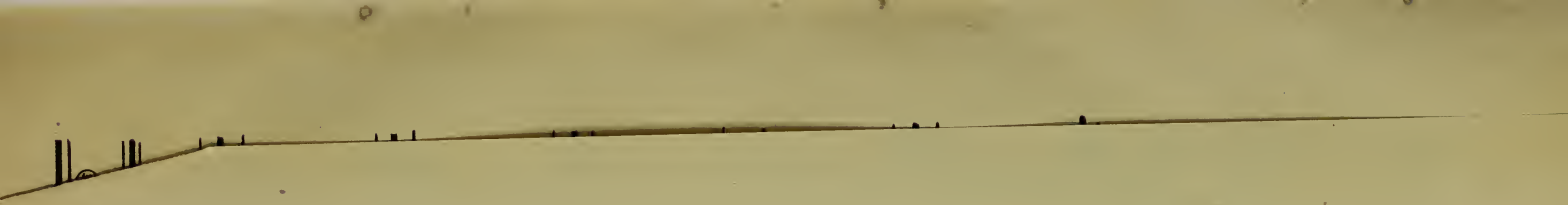


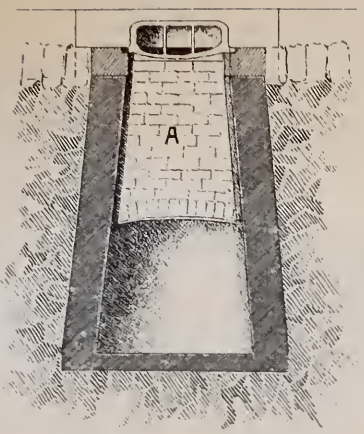
DIAGRAM
OF A
PART OF THE CITY
SHOWING EXCESSIVE AND NEEDLESS CONSTRUCTION OF
BRICK SEWERS

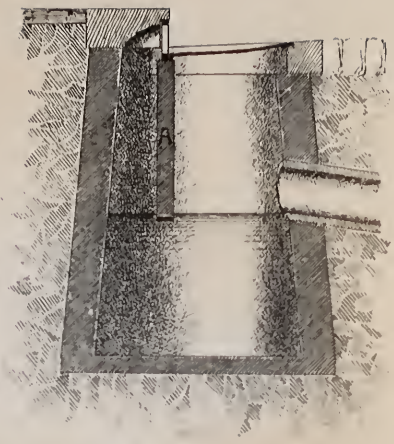
DIAGRAM showing CONSTRUCTION OF CATCH-BASINS OR CESS-POOLS

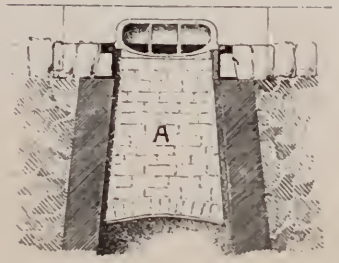
1. *with stone-cover on side-walk and stone-coping to well.*

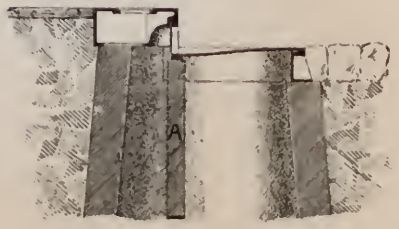
2. *with iron cover on side-walk and iron rim to well.*

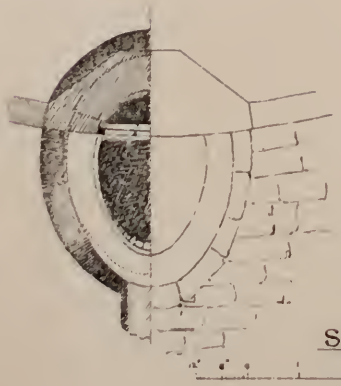
Note: *The same constructions are applied without the trap-wall A.*

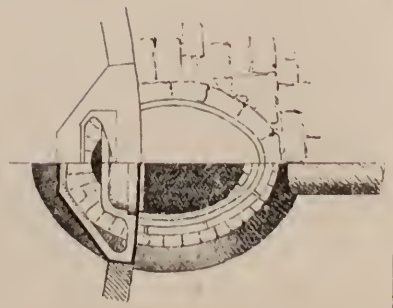








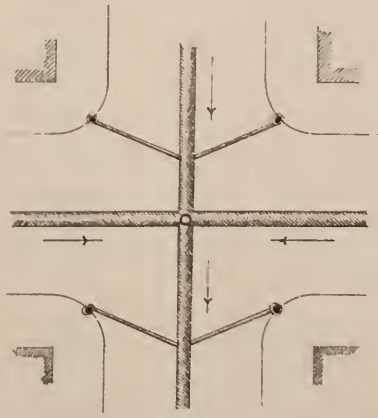


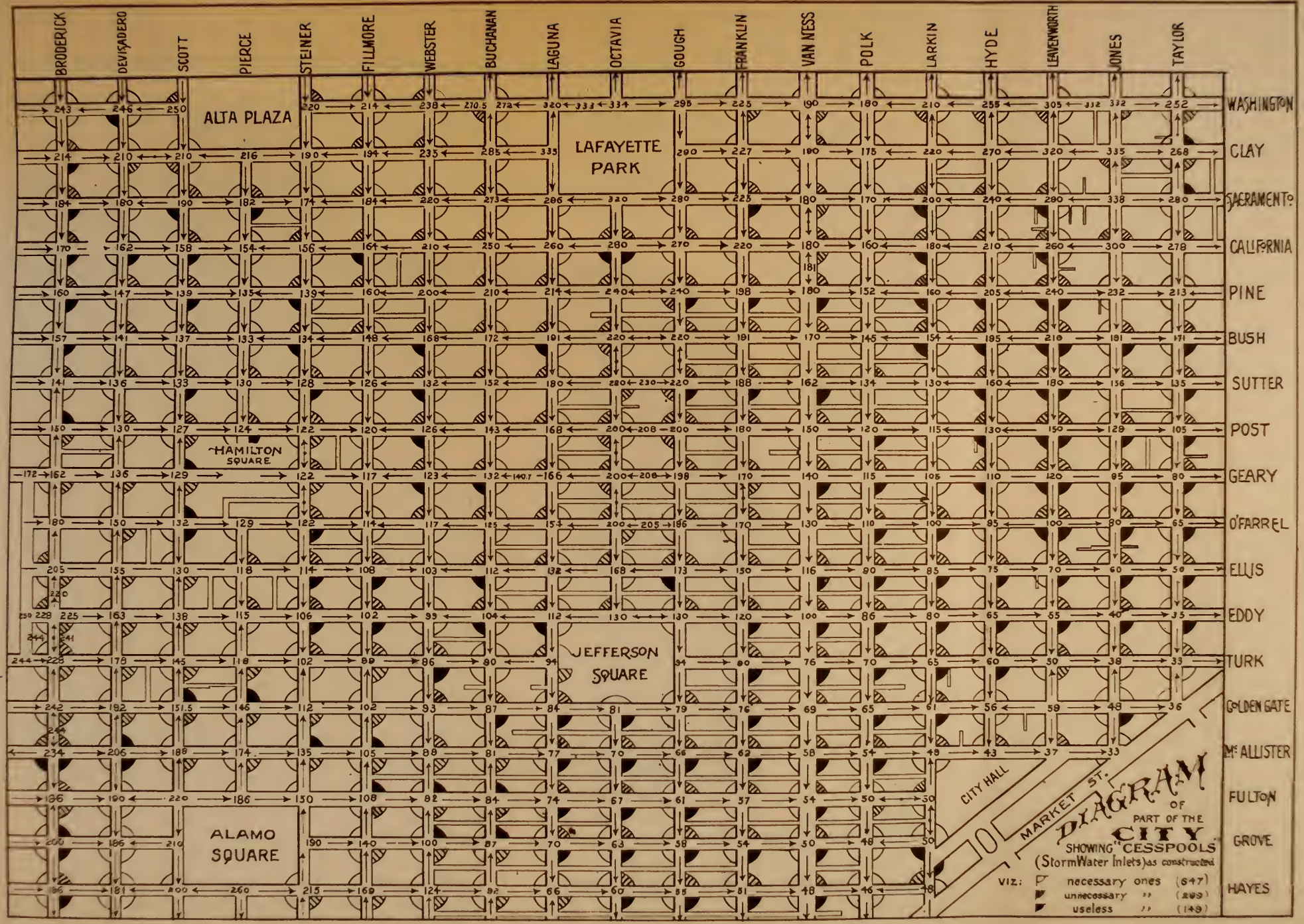


Scale:

Arrangement of cess-pools and drains to sewer:

Scale:




BRODERICK
DEVISADERO
SCOTT
PIERCE
STEINER
FILLMORE
WEBSTER
BUCHANAN
LAGUNA
OCTAVIA
GOUGH
FRANKLIN
VAN NESS
POLK
LARKIN
HYDE
LEAVENWORTH
JONES
TAYLOR
WASHINGTON
CLAY
SACRAMENTO
CALIFORNIA
PINE
BUSH
SUTTER
POST
GEARY
O'FARRELL
ELLIS
EDDY
TURK
GOLDEN GATE
McALLISTER
FULTON
GROVE
HAYES
ALTA PLAZA
LAFAYETTE PARK
HAMILTON SQUARE
JEFFERSON SQUARE
ALAMO SQUARE
CITY HALL
MARKET ST.
DIAGRAM
OF
PART OF THE
CITY
SHOWING "CESSPOOLS
(StormWater Inlets) as constructed
VIZ: necessary ones (647)
unnecessary " (209)
useless " (149)

answer is given it will be well to look into the matter a little further. On paved streets they receive the material which should be carried off by street sweepers, principally horse manure, waste paper and fine light silt. To the extent that this is carried into storm water inlets by gutter water there is no objection to receiving it into the sewers. It goes there at the present time though, through or across the top of the accumulation already in the basin. It can be kept out of the sewers only by careful and thorough street sweeping or by much more frequent cleaning of catch basins. The catch basins not only receive this material by water carriage, but it, garbage and other waste is often forced into them by hand. The basin itself, from which the overflow into the sewer occurs, is so large that small volumes of water entering the basin during the summer months, do not carry off even the light organic matter which floating for months on the basin slush makes perfect cesspools of these silt basins, parts of which are always directly open to the air.

Their use on paved streets is therefore to be condemned and a very simple and much cheaper form of rain water inlet, with valve and water trap, should be substituted for them. We have not yet agreed upon the best form to be adopted for this purpose, but hope to perfect a design adapted to local conditions at an early date.

On macadamized streets, on streets that have been merely graded and in the vicinity of unimproved property where drifting sands reach the gutterways, no argument is required to demonstrate the importance of intercepting the silt that the rains gully out of sand drifts, natural soils and macadamized streets before it reaches the sewers. To the extent of their capacity this is accomplished by the silt basins now in use. But notwithstanding their limited efficiency in this respect, we found some 2000 cubic yards of silt of this character still in the Channel street system of sewers from Fourteenth to Eighteenth streets and from Channel to Mission streets after a very much larger amount had already been removed since January 1, 1893, by the Superintendent of Streets.

It will certainly be economical to intercept the material of this character before it enters the sewers, instead of being compelled to remove it from them later by more expensive methods. It is particularly desirable to thus intercept it, because its presence in the sewers may interfere with adequate drainage during rainstorms, and obstructs sewerage flow at all times.

Much can be done towards intercepting material of this character by removing accumulations of the same from street and gutter surface; but for that which is carried along by rainwater temporary catch-basins should be provided of such size that they will hold the amount likely to be swept down to them by single heavy storms. These temporary silt interceptors could be retained in use until the street surface is permanently improved.

Right here it may be well to say that in the matter of street paving, as well as sewering, San Francisco has long felt the want of intelligent engineering supervision, and we desire to make the pertinent suggestion that hereafter all cobble stone or broken rock gutterways on macadamized streets should be thoroughly grouted with cement mortar.

Under all circumstances, however, provision must be made for frequent inspection of catch-basins, and for a frequent removal of silt from them, particularly during the winter months.

It is required by the specifications for paving with granite or basalt blocks that the entire surface paved shall be "covered to a depth of not less than one (1) inch with fine beach gravel or clean hard rock finely broken and screened," and for paving with cobbles that the cobbles shall be "covered to the depth of two inches with beach gravel or finely broken blue gneiss rock." In the residence portion of the city cobbles and basalt blocks are used for paving principally on streets whose gradients are too heavy for the smooth surfaced bituminous rock. The fine stuff put upon the surface is in such cases invariably swept down by the first rains of winter to the lower crossing and has thence to be removed from street surface, catch-basins and sewers. It is a fruitful source of the many annual complaints of "clogged cesspools." The specifications for paving need revision, for it is folly to pay for an unnecessary top dressing that must invariably be picked up again at increased expense, and which to a large extent finds permanent lodgment in the sewers of light grade.

As in the case of rain water inlets we propose to recommend at an early day a serviceable catch-basin for use where much heavy silt is to be intercepted.

RAINFALL.

When the Board of Engineers entered upon the discharge of its duties, it was supposed that so far as it would be necessary to make rainfall and the rate of rainfall an element in the determination of volume of drainage to be provided for in each district of this city, there would be ample data available among the United States Weather Bureau and private weather records. But, upon inquiring, it was found that maximum rate of fall for short time periods had never been determined for any of the severe storms, and is to-day unknown. The weather service station in this city is not even equipped with a rain gauge that will enable a reliable determination of the rate of fall. Totals are recorded at fixed time intervals (generally eight or twelve hours), but no information is available as to variations in the rate of fall between the hours of recording the totals.

It is not sufficient to be able to say that there probably never will be a rainfall that will yield an inch of water per hour. Information must be had as to the maximum rate for short as well as for long time periods. It will be necessary to approximate this rate on the basis of all the available information for half hourly, hourly and longer periods, and this approximation must be made before recommendations as to size and character of main lines of sewers can be intelligently made.

It was also hoped that no trouble would be experienced in determining the present volume of flow of the sewers, but this cannot be done satisfactorily. Sewage is not and cannot be confined to main lines of present sewers, and along the water front the unimpeded tidal ebb and flow in the sewers would invalidate any results of observations near the outfall points.

By a combination of the best data available a basis will this winter be established to serve as a guide in determining volumes of flow, for large and small areas.

MONTHLY RAINFALL FROM 1882 TO 1893.

Authority, SPRING VALLEY WATER COMPANY.

YEARS.	September	October	November	December	January	February	March	April	May	June	July	August
1882-83	0.36	2.36	4.55	1.31	2.53	1.08	3.39	1.62	3.67	0.00	0.00	0.00
83-84	0.29	1.54	1.58	0.59	4.14	6.56	8.34	7.16	0.10	2.56	0.00	0.00
84-85	0.18	2.63	0.25	8.33	2.48	0.37	1.02	3.35	0.03	0.18		
85-86	0.09	0.74	12.27	4.85	8.19	0.07	2.05	4.75	0.31			
86-87		1.35	0.85	2.07	1.89	9.30	0.86	2.30	0.01	0.07	0.22	
87-88	0.24		1.05	3.29	6.81	1.84	4.12	0.10	0.40	0.19		
88-89	1.09	0.10	4.54	6.58	1.38	0.78	8.75	1.09	2.50			
89-90		7.22	3.53	16.46	11.12	5.90	5.47	1.36	1.12	0.09		
90-91	0.32			4.37	1.19	8.53	2.35	2.75	1.38	0.13	0.01	
91-92	0.81	0.07	0.62	7.23	2.87	3.27	3.28	1.46	2.18		0.11	
92-93		1.93	4.74	8.19	4.31	3.61	5.92	1.65	0.21			

MONTHLY RAINFALL—1849 TO 1893.

IN INCHES.

Authority, THOMAS TENNENT.

YEARS.	September	October	November	December	January	February	March	April	May	June	July	August
1849-50	0.00	3.14	8.66	6.20	8.34	1.77	4.53	0.46	0.00	0.00	0.00	0.00
50-51	0.33	0.00	0.92	1.05	0.72	0.54	1.94	1.23	0.67	0.00	0.00	0.00
51-52	1.03	0.21	2.12	7.10	0.58	0.14	6.68	0.26	0.32	0.00	0.00	0.00
52-53	0.00	0.80	5.31	13.20	3.92	1.42	4.86	5.37	0.38	0.00	0.00	0.04
53-54	0.46	0.12	2.28	2.32	3.88	8.04	3.51	3.12	0.02	0.08	0.00	0.01
54-55	0.15	2.41	0.34	0.81	3.67	4.77	4.64	5.00	1.88	0.00	0.00	0.00
55-56	0.00	0.00	0.67	5.76	9.40	0.50	1.60	2.94	0.76	0.03	0.02	0.00
56-57	0.07	0.45	2.79	3.75	2.45	8.59	1.62	0.00	0.10	0.12	0.00	0.05
57-58	0.00	0.93	3.01	4.14	4.36	1.83	5.55	1.55	0.34	0.05	0.05	0.16
58-59	0.00	2.74	0.69	6.14	1.28	6.32	3.02	0.27	1.55	0.00	0.00	0.02
59-60	0.03	0.05	7.28	1.57	1.64	1.60	3.99	3.14	2.86	0.09	0.21	0.00
1860-61	0.00	0.91	0.58	6.16	2.47	3.72	4.08	0.51	1.00	0.08	0.00	0.00
61-62	0.02	0.00	4.10	9.54	24.36	7.53	2.20	0.73	0.74	0.05	0.03	0.00
62-63	0.00	0.40	0.15	2.35	3.63	3.19	2.06	1.61	0.23	0.00	0.00	0.00
63-64	0.03	0.00	2.55	1.80	1.83	0.00	1.52	1.57	0.78	0.00	0.00	0.21
64-65	0.01	0.13	6.68	8.91	5.14	1.34	0.74	0.94	0.63	0.00	0.00	0.00
65-66	0.24	0.26	4.19	0.58	10.88	2.12	3.04	0.12	1.46	0.04	0.00	0.00
66-67	0.11	0.00	3.35	15.16	5.16	7.20	1.58	2.36	0.00	0.00	0.00	0 00
67-68	0.04	0.20	3.41	10.69	9.50	6.13	6.30	2.31	0.03	0.23	0.00	0.00
68-69	0.00	0.15	1.18	4.34	6.35	3.90	3.14	2.19	0.08	0.02	0.00	0.00
69-70	0.12	1.29	1.19	4.31	3.89	4.78	2.00	1.53	0.20	0.00	0.00	0.00
1870-71	0.03	0.00	0.43	3.38	3.07	3.76	1.29	1.93	0.21	0.00	0.00	0.00
71-72	0.03	0.11	3.72	16.74	4.22	6.97	1.64	1.10	0.16	0.02	0.00	0.00
72-73	0.14	0.21	2.62	7.25	2.17	4.24	0.78	0.52	0.01	0.08	0.03	0.15
73-74	0.00	0.68	1.31	10.12	4.85	1.83	3.55	1.04	0.34	0.08	0.00	0.00
74-75	0.08	2.73	5.92	0.23	6.97	0.20	1.08	0.02	0.11	1.01	0.00	0.00
75-76	0.00	0.22	6.73	3.08	6.41	3.96	4.37	1.04	0.18	0.02	0.01	0.02
76-77	0.26	2.69	0.23	0.00	4.36	1.14	0.91	0.25	0.13	0.00	0.00	0.00
77-78	0.00	0.58	1.38	2.37	10.69	10.75	4.26	0.96	0.12	0.01	0.01	0.01
78-79	0.62	1.19	0.52	0.62	4.23	4.67	8.26	2.29	2.13	0.01	0.02	0.00
79-80	0.02	0.63	2.25	6.31	2.27	1.96	1.82	10.02	1.08	0.00	0.00	0.00

MONTHLY RAINFALL—1849 TO 1893—CONCLUDED.

Authority, THOMAS TENNENT.

YEARS.	September.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.
1880-81	0.00	0.02	0.41	11.43	8.11	4.32	0.45	1.83	0.18	0.76	0.00	0.00
81-82	0.23	0.48	1.86	3.90	1.40	2.83	3.45	1.20	0.22	0.05	0.00	0.00
82-83	0.24	2.62	4.14	2.07	1.97	1.10	2.83	1.39	3.47	0.00	0.00	0.00
83-84	0.45	1.45	1.55	0.87	3.94	6.53	8.16	6.15	0.22	2.44	0.00	0.00
84-85	0.31	2.51	0.28	7.44	2.42	0.32	0.96	3.20	0.06	0.21	0.06	0.00
85-86	0.12	0.72	11.60	5.03	7.32	0.27	2.01	5.24	0.35	0.01	0.26	0.00
86-87	0.01	1.54	0.61	2.05	1.93	9.18	5.84	2.27	0.05	0.03	0.00	0.00
87-88	0.27	0.00	0.01	3.27	6.75	0.95	3.60	0.11	0.37	0.12	0.30	0.00
88-89	1.03	0.06	5.40	4.39	1.35	0.58	7.74	0.62	0.23	0.02	0.00	0.00
89-90	0.01	7.42	2.99	14.01	9.69	3.53	6.11	1.20	1.10	0.10	0.02	0.00
1890-91	0.14	0.00	0.02	3.27	0.99	7.88	1.34	4.65	1.26	0.18	0.14	0.17
91-92	0.91	0.28	0.90	5.65	2.75	2.67	3.20	1.35	1.89	0.00	0.00	0.00
92-93	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE OF HEAVIEST 24-HOUR PRECIPITATION IN SAN FRANCISCO FROM 1871 TO 1893.

Authority, U. S. WEATHER BUREAU.

	Inches.
24 hours ending 11.43 P. M. December 18th, 1871	2.83
24 hours ending 11.43 P. M. December 19th, 1871	3.12
48 hours ending 11.43 P. M. December 19th, 1871	5.95
24 hours ending 10.08 P. M. November 23rd, 1874	3.98
24 hours ending 4.48 P. M. March 5th, 1879	3.31
24 hours ending 11.08 P. M. January 29th, 1881	4.76
24 hours ending 11.00 P. M. November 24th, 1885	2.58
11 hours ending 1.35 P. M. December 21st, 1885	2.78
24 hours ending 4.00 P. M. February 5th, 1887	3.60
24 hours ending 8.00 A. M. March 13th, 1889	3.08
24 hours ending 8.45 P. M. February 15th, 1891	3.38
24 hours ending 4.00 P. M. December 29th, 1891	2.21
24 hours ending 4.45 P. M. November 28th, 1892	1.46
24 hours ending 3.40 A. M. December 3rd, 1892	2.34
24 hours ending 12.35 P. M. January 30th, 1893	1.39
24 hours ending 11.35 A. M. February 9th, 1893	1.06
24 hours ending 7.40 P. M. March 11th, 1893	0.98
24 hours ending 9.00 P. M. April 6th, 1893	0.71

MONTHLY RAINFALL FROM 1870 TO 1893.

IN INCHES.

Authority, U. S. SIGNAL SERVICE.

YEARS.	September	October	November	December	January	February	March	April	May	June	July	August
1870-71	0.04	0.00	0.47	3.30	2.63	3.53	1.05	1.89	0.23	0.01	0.00	0.02
71-72	0.00	0.07	2.81	14.36	4.00	6.90	1.59	0.81	0.18	0.04	0.01	0.00
72-73	0.04	0.11	2.79	5.95	1.58	3.94	0.79	0.43	0.00	0.02	0.01	0.08
73-74	0.00	0.83	1.16	9.72	5.66	2.21	3.36	0.90	0.66	0.14	0.00	0.00
74-75	0.02	2.69	6.55	0.33	8.01	0.32	1.30	0.10	0.22	1.02	0.00	0.00
75-76	0.00	0.24	7.27	4.15	7.55	4.92	5.49	1.29	0.24	0.04	0.01	0.01
76-77	0.38	3.36	0.25	0.00	4.32	1.18	1.08	0.26	0.18	0.01	0.02	0.00
77-78	0.00	0.65	1.57	2.66	11.97	12.52	4.56	1.06	0.16	0.01	0.01	0.00
78-79	0.55	1.27	0.57	0.58	3.52	4.90	8.75	1.89	2.35	0.05	0.01	0.02
79-80	Trace	0.78	4.03	4.46	2.23	1.87	2.08	10.06	1.12	0.00	0.00	0.00
1880-81	0.00	0.05	0.33	12.33	8.69	4.64	0.90	2.00	0.22	0.69	0.00	0.00
81-82	0.25	0.54	0.94	3.85	1.68	2.96	3.45	1.22	0.21	0.04	0.00	0.00
82-83	0.26	2.66	4.18	2.01	1.92	1.04	3.01	1.51	3.52	0.01	0.00	0.00
83-84	0.42	1.48	1.60	0.92	3.94	6.65	8.24	6.33	0.23	2.57	Trace	0.04
84-85	0.33	2.55	0.26	7.68	2.53	0.30	1.01	3.17	0.04	0.19	0.06	Trace
85-86	0.11	0.72	11.78	4.99	7.42	0.24	2.07	5.28	0.37	0.01	0.23	Trace
86-87	0.01	1.48	0.84	2.07	1.90	9.24	0.84	2.30	0.06	0.07	Trace	0.01
87-88	0.29	Trace	0.99	3.34	6.81	0.94	3.60	0.11	0.38	0.27	0.01	0.01
88-89	0.98	0.13	3.99	5.80	1.28	0.72	7.78	0.96	2.17	0.03	0.01	Trace
89-90	Trace	7.28	2.90	13.81	9.61	5.16	4.73	1.18	1.07	0.10	0.02	0.00
1890-91	0.31	0.00	0.00	3.25	0.98	7.26	1.96	2.44	1.25	0.11	0.10	0.02
91-92	0.77	0.04	0.56	5.62	2.42	2.90	2.85	1.39	1.86	Trace	0.00	0.00
92-93	0.02	1.65	3.91	5.08	3.05	2.75	4.08	1.03	0.15	0.03		

STREET GRADES.

We append to this report a compilation of official street grades complete to the date of this report, and which we hope may be found convenient to publish. All grade tables heretofore published have named intermediate grades in separate lists, distinct from those for grades at street crossings. This has made the use of published lists very inconvenient, and has been a fruitful source of error in making grade changes, because the existence of intermediate grades was very apt to be overlooked. In the table now presented the grades are mentioned in consecutive order. All streets are arranged alphabetically, and so far as possible streets have been correctly named. Where names of streets have recently been changed both the old and the new names have been carried into the grade table.

This compilation of grades which we have made in connection with our investigations, was incidental to the making of a correct topographical map of the city, to serve as a basis of estimates of volumes of flow and will be of material aid in determining lines of main drainage.

It was very soon discovered that on nearly 300 miles of streets, which have been dedicated to public use, grades have not yet been officially established, and that in many portions of the city grade changes should be made before expensive local improvements are made by property owners that will render the making of such changes difficult. Reference has already been made to the necessity for a revision of grades on 15th Avenue south, and at points on San Bruno Road. To these examples from the Islais Creek basin may be added the South San Francisco or Hunter's Point section, where the official grades in some instances give the two sides of the same street different elevations. This difference in height is frequently 20, 40, 60 and even 80 feet, while the rise from street to street rarely exceeds 10 per cent. That such an arrangement might be acceptable on wide streets, in a district where lots are unusually valuable for residence or other purposes' may be admitted, but it is ill-advised and unnecessary in South San Francisco, and a complete revision of grades in this district should be had at an early day.

In this connection we must call attention to the necessity for determining with great precision the elevation of a number of permanent reference points. It has long been customary to determine elevations on the basis of benchmarks, that have been established at the convenience of the assistants employed by the City and County Surveyor. These have generally been the tops of hydrants, the tops of storm water inlets, the sidewalk curb, water tables of permanent buildings, door step or other convenient objects. Although all leveling is checked by connecting each line at both ends with points whose elevation has before been determined, it must be apparent that by reason of an accumulation of small errors the actual reference plane may be somewhat at variance in different parts of the city, and that a similar variation may be caused by a general subsidence of street and building areas reclaimed from submerged or swamp lands, as in the case of some parts of the city east of Montgomery street and others south of Market street.

To avoid the confusion sure to result if the present practice is continued there should be one point selected somewhere near the City Hall, whose elevation after being carefully determined shall be made the basis for a settlement of all controversies that may arise relating to elevation above city base. The reference to an ordinary high-tide mark on a pile, somewhere on the water front, is too indefinite, and the elevation of the point itself is too uncertain and unreliable to be of any great value. City base as defined by reference to such a point is too uncertain a plane to be entirely satisfactory.

Once selected, the central reference point or city bench mark can be made the starting point for continuous lines of levels to all parts of the city throughout which reliable points should be established for convenient use, and for the protection of the property owners.

Speaking of the necessity for establishing permanent reference points S. Harrison Smith in his report as City and County Surveyor in 1887, says:*

"I find the official elevations which we have at our command are, in many instances, unreliable, and often scattered. This is not to be wondered at when one considers that about twenty years have elapsed since any line of consecutive levels has been run up from the city base, and of necessity many errors have crept in, and many of the old original points disappeared."

For further information concerning city base and street grades and the various statutes, orders and regulations in force defining the relative elevation of the different portions of the street surface, we refer to the supplement accompanying this report.

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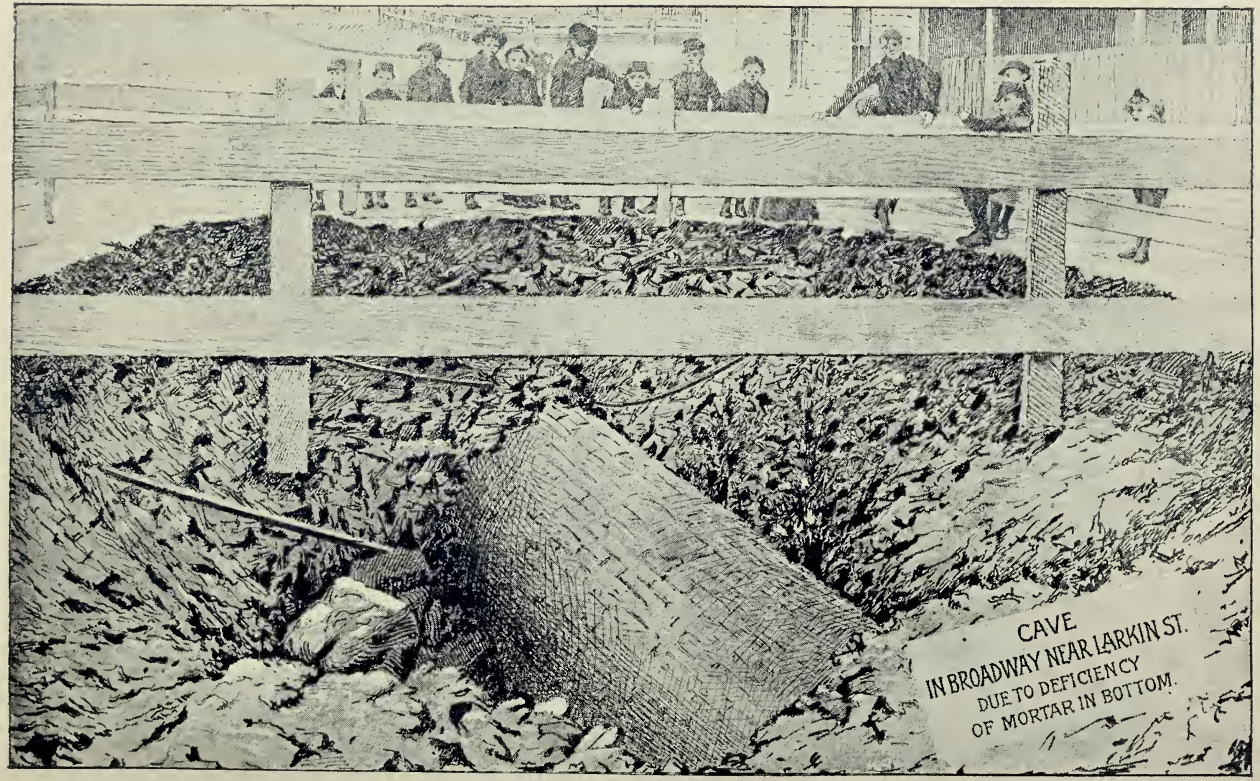
* Mun. Rep. 1886-87, p. 313.



CAVE
IN BROADWAY NEAR LARKIN ST.
DUE TO DEFICIENCY
OF MORTAR IN BOTTOM.

SHALL THE LACK OF SYSTEM BE CONTINUED?

The duties assigned by law to the Superintendent of Streets in connection with ordinary sewer work, and all other street work, are those of a supervising Civil Engineer, as well as Inspector. To fully discharge these duties this official should not only himself be a skillful civil engineer, but should have a number of engineer assistants connected with his department. As no provision is made in the law for such assistance he might rely upon the City and County Surveyor for this service, but the City and County Surveyor receives only a nominal salary of $500 in lieu of all fees or other charges for official services, which would otherwise be a city and county charge, and is permitted to charge fees for services rendered individuals in connection with surveys and street work.

If he is called upon to certify to the correctness of line and grade of any particular piece of work he must be paid for this service, and the builder of the same must stand the charge. The service, if rendered at all, is rendered when the work is offered for acceptance, and the examination extends to those portions only which are conveniently accessible. When the Surveyor is thus called upon he certifies to the facts as he finds them, not necessarily to the fact that the work has been done to the prescribed line and grade. His certificate is therefore of value only as a source of information to the Superintendent of Streets. As work has often been passed which was at fault even at the few points where tested by the Surveyor, it is highly probable that the chief purpose in requiring a surveyor's certificate (for work when not required by law) has been a favor to that official to enable him to collect a fee.

The present system has led to the acceptance of much defective work, and its maintenance is costing the city large sums annually. The records of breaks in sewers and the undermining of street surface, and the collapse of street pavements at nearly 150 different points during the last winter may be cited in illustration of this statement. In nearly every instance the damage to sewer and street was caused by an inflow of water into the sewer through open joints in the pipe sewer, or in the brickwork, or alongside of improperly made connections of house drains with sewer mains. Water thus entering the sewer carried with it sand and soil, undermining the street pavement, and in the general collapse, frequently causing a destruction of the sewer.

In some instances lack of mortar in the invert has caused extensive breaks in the street surface, all the material from which was carried into the sewer through the joints of the masonry, and yet there were no serious defects apparent in the sides and arch of the sewer, as thus exposed for distances of 10 to 20 feet.

It is not necessary to encumber this progress report with a full record of individual instances of defects of design and construction. Those that have already been presented will suffice to make clear that the administrative system is at fault and that the present condition of the sewers fully justifies the oft-repeated demands for relief. In this connection Dr. I. Rowell, in his report as Health Officer in 1869, says:*

"That a change is necessary in the disposition of refuse matter that now finds an escape through our public sewers, is apparent to all. The method of disposing of filth in this city is the most wretched of any city in the civilized world. First, it is made obligatory by law for all privy vaults to be connected with the public sewers, which law is only heeded when convenient. Second, the stench caused of the contents of these vaults with the immense quantity of refuse matter from kitchens and back yards, is sent on its sluggish course through the sewers to the bay, discharging through the open vents at every street corner a volume of disease-bearing effluvia that would cause any animal but man to rush in wild disorder from the spot, and avoid it thereafter as the burned child avoids the fire. If privy vaults are to have their contents emptied into sewers, then the vents at street corners should be sealed by water, or otherwise, so as to prevent the gases escaping from them. Even then the city front, where all the sewers empty, would, as now, be a pool of stagnant filth, the effluvia from which is sufficient to poison the atmosphere of the whole of that portion of the city that lies on the low land."

A year later Dr. C. M. Bates, the successor of Dr. Rowell, in a similar vein writes:†

"Public Sewers—This is a subject of the most vital importance, and without its appreciation and proper regulation it is impossible to maintain the health of the city and prevent the occurrence of malignant and fatal diseases. It is to be very much regretted that so much has been said and written on this subject, while but little or nothing has been accomplished."

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*Mun. Rep. 1868-69, p. 217.
†Mun. Rep. 1869-70, p. 231.

There is a radical defect in our system of sewerage, which must be corrected sooner or later, and the longer it is deferred the greater will be the evil and the more difficult its removal. The southwestern portion of the city is in more immediate want of this reform than any other. The entire grade of that portion of the city will have to be raised along and for several blocks from the water front.

The plan suggested by His Honor, Mayor Selby, is one that is apparently feasible, and will cost as little as any yet proposed. It is to construct a reservoir on top of Russian Hill, or some eminence contiguous to the bay, in order that with suitable machinery the reservoir may be filled with salt water. The reservoir is to be connected with "the main sewers by means of aqueducts, so that they may be flushed or washed out as often as occasion may require, to keep them from filling up or becoming foul or offensive. This method would in every way remedy the evil, provided there is fall enough in the sewers in the extreme southern portion of the city, which is doubtful."

Two years later Dr. Bates again called attention to the defective sewer system, and says :*

"The fact is well established that the cause of many diseases that carry off hundreds of our population annually has been traced with almost perfect certainty to what may be called defective sewerage, or sewerage contamination. We mean by this that they originate indirectly, if not directly, from human excrements being kept in undue proximity to dwellings, undergoing putrid fermentation or decomposition, which allows its gases to penetrate the houses or finds its way into springs and wells from which drinking water is obtained. The diseases most commonly arising from this cause are typhoid fever, sporadic cholera, cholera infantum, diarrhea and dysentery."†

* * * * * * * * * *

"We had a decided increase in cholera infantum, which is to be attributed, in a great measure to improper food and care of infants while teething, but more particularly to the poisoned atmosphere which is the consequence of lack of proper sewage. This is proven in table No. 111 (see Mun. Rep. 1871-72, p. 224), which shows that of the ninety-one deaths the Second, Tenth, Eleventh and Twelfth Wards furnished more than one-half, and from the fact that these wards have very little sewerage that is of any account. The number of deaths from typhoid fever is still larger than it should be, but we cannot hope for much diminution until a better and more general system of sewerage is carried out."*

Hon. Thos. H. Selby, at the close of his term as Mayor, said :‡

"A kindred subject is that relating to the establishment of a Board of Public Works, which under the guidance of practical scientific ability, should originate and recommend the changing of established grades and other important street improvements, and especially have control of the subject of sewerage, upon which, more than all else, the public health depends.

"Two years ago I suggested that the sewers might be flushed from reservoirs constructed on the hills, to be filled from the bay by pumping," etc. * * * * * "This, or some other expedient, should be adopted for cleansing the sewers, which are a prolific source of disease, and in lower streets, along the water front, are often choked up by the tides, and their contents forced back upon the city. The cesspools at the street corners should be kept filled with water to prevent the escape of effluvia, and the strictest surveillance exercised over all the private sewers to see that they are properly trapped and kept in good order."

Hon. Wm. Alvord called attention to the need of reform in the matter of sewer construction and necessity for engineering control upon retiring from the mayoralty, but had already voiced public sentiment in his inaugural address, in which he said :§

"Our worthy retiring Mayor called the attention of your predecessors to the importance of having the sewers flushed out once or twice a week during the dry season, but the suggestion was not acted upon, and I deem it my duty to call your attention to the important matter, and to recommend that some action be taken to secure this object before the return of another dry season. * * * * I would advise before any action be taken in the matter, that our most eminent engineers be consulted, and requested to furnish reports on the cheapest and best plan for flushing out the principal or main sewers. Some changes in the size, form and manner of constructing sewers for the elevated portions of the city may be advisable, and I think should be inquired into. There is a necessity for a new plan of draining the level districts by which the sewers can be kept free from deposits and deleterious gases."

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*Mun. Rep. 1871-72, p. 217.
†Mun. Rep. 1871-72, p. 213.
‡Mun. Rep. 1871-72, p. 613.
§Mun. Rep. 1871-72, p. 623.

To the necessity for a more scientific treatment of the sewage problem, Dr. Henry Gibbons, Jr., while Health Officer, repeatedly called attention. The following is from his report in 1873:*

"But this is not all; some of the sewers we have are worse than useless, and the outlets of others are arranged in the worst possible manner. * * * * Truly the winds are our salvation, as has so often been said. Nor is this an idle statement, Our statistics prove that nearly one-half of all deaths from zymotic causes occur in the four months, September, October, November and December, or after the summer winds have ceased and before the rains have carried off accumulated filth. Our sister city, Chicago, has passed through a sad experience in regard to sewers. Cannot San Francisco profit by it rather than wait until some deadly scourge is at her gates? For five years prior to the construction of sewers in Chicago, from 1849 to 1885, the death rate was nearly 49 per 1000, or larger than in any other city in the United States. In the succeeding six years, fifty-four miles of sewers were constructed, and the rate fell to 23 per 1000. For a third period of five years only 30 miles of sewers were constructed, while the population very greatly increased, and the rate increased to nearly 26 per 1000, and finally in a fourth period, the miles of sewers constructed being 80, the rate again fell to 23 per 1000. Comment is unnecessary."

Two years later Dr. Gibbons writes:†

"Unfortunately our sewer system is very objectionable, crude and expensive, and all works of magnitude, however urgent, are liable to delay from opposition to property holders. It does not seem just that one property owner should be charged a hundred dollars for what another was to pay but twenty, yet such is the operation of the present system. Undoubtedly the tubular or pipe sewer might be adopted in many cases where the brick sewer is now considered necessary, but these matters should be under the direct supervision of an engineer specially appointed for that purpose."

Hon. James Otis, Mayor of the city, addressing the Board of Supervisors in 1874, said:‡

"The very imperfect manner in which many parts of the City are now drained, and the daily and increasing difficulties arising, calls for immediate action, and should you deem it necessary to the purpose, further powers should be obtained for the Legislature to enable you to do what every sanitary precaution would demand. I would suggest that a general revision of the matter should be had, and should your Honorable Body deem fit, a corps of competent engineers employed to present some plan for your adoption."

A year later Superintendent of Streets S. H. Kent, in his annual report, again calls attention to the need for competent control of street and sewer work.§ "There should be a Board of Public Works. * * * * * *

"The reconstruction of our sewers, making them large enough to carry the gas and water mains should be seriously considered."

Mr. William P. Humphreys, at that time City and County and County Surveyor, may be quoted from his report for the years 1874-75 as follows:**

"I have for years advocated before the Legislature the creation of a Board of Engineers, who should prepare a proper system of sewerage, laying down on their maps the size of each and every sewer, which size should be determined by the water-shed, the inclination of the sewer and the amount of house sewerage; also a system of ventilation, for it has been found in cities in Europe where complete systems of sewerage have been established and the ventilation neglected, that malignant fevers followed, which upon close examination by Commissioners appointed for that purpose, were found to be caused by the want of proper ventilation; that being provided for, the fevers ceased, and those places are now amongst the healthiest in Europe"

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*Mun. Rep. 1872-73, p 344.
† Mun. Rep. 1874-75, p, 303.
‡ Mun. Rep. 1873-74, p. 647.
§ Mun. Rep. 1874-75, p. 136.
**Mun. Rep. 1874-75, p. 60.

Health Officer Dr. J. L. Meares in 1877 says:*

"The only remedy is to place the construction and reconstruction of our sewers under the charge of a practical and scientific engineer, whose duty it shall be not only to recommend the specifications under which the sewers shall be constructed and reconstructed, but he, or one of his assistants, should supervise the building of the same, and require all the terms of the contract to be faithfully performed. The house drainage, being of equal importance, should also be placed under his supervision. No house should be connected with a sewer without his permit. He should be the judge of the material to be used and should see that the connection be properly made, with efficient traps and ventilation."

He repeatedly calls attention to the sewers in his annual reports, and in 1883 says:†

"Besides keeping the sewers clean by frequent flushing and thorough ventilation, I desire to call particular attention to the necessity of extending these sewers to deep water. They at present discharge their foul contents into docks, into shallow water and, in some instances, into basins within the sea wall, which wall, as it is extended, will obstruct, necessarily, more and more of the outlets, thereby increasing this nuisance, which, in some portions of the city, is almost intolerable. I would also urgently call your attention to the grading and connecting the streets from Potrero to San Jose avenue with Army street, that this great Army street sewer may be utilized by draining 1000 acres of the city territory. The large basin formed by Precita creek could then be filled in and this portion of the city made not only more healthful, but more desirable to live in."

Two years later, Dr. Meares says:‡

"The filthy condition of many of our sewers south of Market street and in other portions of the city which are below grade, demands your immediate attention. Many of them are to-day and have been for months, filled to their arches with decaying vegetable and animal matter. By your ordinances you compel people to connect their houses with these sewers (elongated cess-pools), the foul offensive and noxious air from which penetrates their houses, producing not only discomfort but disease. During rainstorms the sewage from these so-called sewers frequently overflows basements, dining-rooms and kitchens to the depth of two or three feet. I know of sewers in several blocks that have been in this condition for more than six months. The Superintendent of Streets informs me that he is powerless to clean these sewers for want of sufficient appropriation. * * * *

"I desire to call your attention to the disgraceful mode of disposing of the garbage of the city. I believe the dumping as at present practiced, to be one of the principal factors in the production of preventable diseases. Not only is this disgusting filth and garbage deposited on the mud flats of the Mission, but in other places equally objectionable, and in violation of all sanitary conditions.

And in his next annual report:§

"The defects of our sewerage system, especially south of Market street and east of Montgomery street, have been so much discussed that every citizen of ordinary intelligence must be satisfied that these defects should be remedied; that large portions of this territory, with its buildings, must be raised, or pumping reservoirs established to force the sewerage into deep water. That expensive intercepting sewers must also be constructed. These improvements will necessitate the expenditure of a large amount of money. When undertaken, this great work must be completed in the shortest possible time, for the necessities of traffic, trade and travel will not permit of delay in its completion. * * * The construction of new sewers and the reconstruction of the old ones should be under the control of a sanitary engineer."

Hon. Washington Bartlett in his inaugural address in 1883 refers to the necessity for devising some means of relieving the choked and defective condition of the sewers. He says:**

"Much of the unhealthiness of the city, especially the southern portion, is attributed to the choked and damaged condition of the sewers. To a certain extent this condition of the sewers is due to neglect and defective construction. Certainly some comparatively inexpensive plan of flushing them and clearing out the accumulated contents can be devised which if faithfully carried out will in a great measure afford a proper remedy."

Superintendent of Street, Thos. Ashworth, in 1887, refers to the necessity for devising a sewer system in these words:††

*Mun. Rep. 1876-77, p. 39.
†Mun. Rep. 1882-83, p. 390.
‡Mun. Rep. 1884-85, p. 228.
§Mun. Rep. 1885-86, p. 374.
** Mun. Rep. 1882-83, p. 83.
††Mun. Rep. 1886-87, p. 409.

"Considerable public attention has been given lately to the question of designing and adopting a proper system of sewers, and I am satisfied that this will have to be done in the near future. I presume that the system or plan which will be most acceptable will be that which will aim to utilize, as far as possible, those which have already been constructed.

"With that idea in view I have aimed to have all the sewers which have been constructed since my advent to this office built of sufficient capacity to suit the locality in which they are situated, and also large enough to receive and discharge the flow of all those which may be tributary to them."

And in his next annual report he says:*

"The large amount of sewers constructed during the past fiscal year indicate more than any other item in this report the material progress of this city. In almost every instance they have been recommended by either property-owners or by the Health Officer. As no sewer system has yet been devised which it is possible to adopt and have constructed in the near future, I have aimed to have those which have been built during my incumbency of this office so constructed that while they suit the exigencies of the present time, they will become a portion of any practicable plan which may be adopted in the future."

Hon. E. B. Pond, in his second inaugural address (1889), says:†

"Urgent necessity, as well as your pledge, requires you to take up the question of the reformation of the sewerage system.

"Steps should be taken at once to carry out your pledge in this regard. No hasty or ill-advised system should be adopted, and only after very careful consideration and under competent advice should you decide what steps are necessary to be taken."

Prof. Davidson of the United States Coast and Geodetic Survey, in his report to the Board of Supervisors in April, 1886, says:

"I recal no city that is so peculiarly situated as San Francisco for its commercial and manufacturing advantages, and for its high possibilities in the application of the principles of sanitation—the increase of population depending upon the former, demands the development of the latter. Yet I fail to recall but one other where the sewerage is in such a deplorably low condition; that exception is the City of Mexico.

* * * * * * * * * *

"Even if these pest-breeding products were promptly carried out by the sewers, they would be deposited with the waters among the wharves. This in itself leads to deposits around our city front, which if not removed by dredging, will make the waters lethean as those of Venice or Amsterdam.

"The sanitation of this city, as of all great cities, is a necessity that cannot be pressed aside; and we cannot ignore the experience of older municipalities that have struggled with defective plans until compelled by the exigencies of the case to adopt larger views and effective methods."

In the examination of the condition of the sewers and their effects upon the healthfulness of the city we are necessarily brought into contact with other prominent causes of filth diseases.

A study of the number of deaths occurring from diseases of this class in each ward is very instructive; and the relation between foul sewers, lack of proper outfall, and putrescent garbage heaps is distinctly shown. The subsequent table gives the number of deaths occurring in each ward from filth (zymotic) diseases from July, 1872, to July 1392, a period of twenty years:

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*Mun. Rep. 1887-88, p. 377.

† Mun. Rep. 1888-89, p. 8 Appendix.

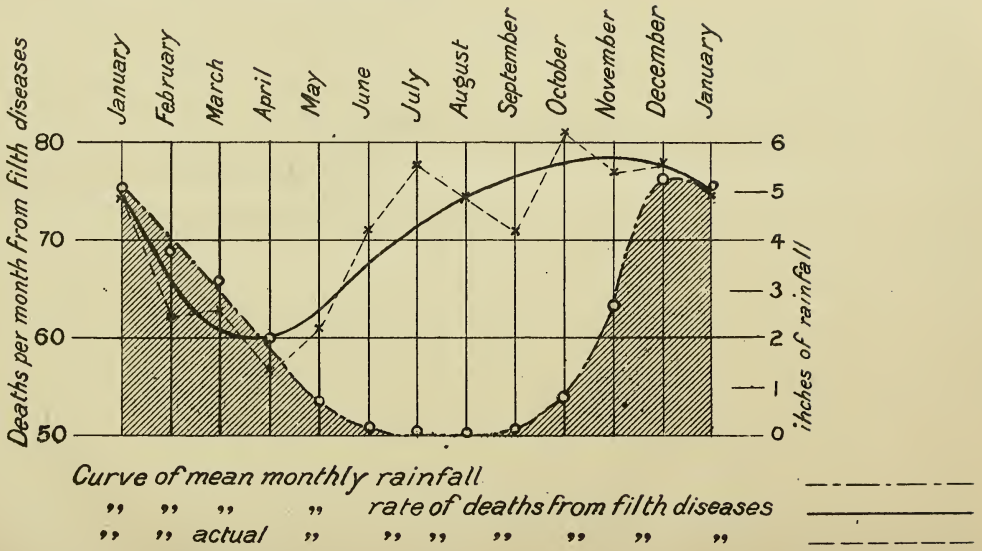
DEATHS FROM FILTH (ZYMOTIC) DISEASES IN THE CITY OF SAN FRANCISCO FOR TWENTY YEARS—BY MONTHS.

YEARS.	January.....	February.....	March.....	April.....	May.....	June.....	July.....	August.....	September.....	October.....	November.....	December.....	TOTALS.....
1873	35	43	54	64	75	87	67	71	69	90	102	130	887
1874.....	88	45	65	46	60	69	102	79	83	88	58	54	837
1875.....	39	51	51	50	58	66	71	71	52	85	92	58	744
1876.....	58	67	62	68	65	157	143	165	196	184	182	223	1,570
1877.....	252	191	171	144	111	105	86	89	95	126	111	119	1,600
1878.....	107	73	60	50	48	56	75	91	80	71	59	70	840
1879.....	70	38	50	36	52	48	52	55	54	69	41	46	611
1880.....	35	35	36	55	16	46	64	67	53	45	73	68	543
1881.....	61	33	28	40	44	51	44	29	30	56	46	41	503
1882.....	77	84	110	44	60	71	67	62	75	68	67	71	856
1883.....	47	36	39	38	25	49	82	59	65	49	51	36	576
1884	41	54	55	38	43	66	85	57	63	58	45	44	649
1885	65	71	72	72	135	117	76	80	55	41	68	71	927
1886.....	57	47	52	57	65	46	76	60	66	76	73	83	758
1887.....	76	57	54	62	62	58	79	48	53	99	83	107	838
1888.....	89	64	42	64	64	68	91	65	54	58	69	53	781
1889.....	38	44	36	45	50	34	63	46	75	87	71	62	651
1890.....	80	33	51	61	42	81	124	99	58	102	113	101	945
1891.....	95	90	105	58	69	69	107	101	76	99	80	83	1,032
1892.....	85	79	71	55	71	80	79	76	62	68	50	50	816
	1,495	1,235	1,264	1,147	1,215	1,424	1,573	1,470	1,418	1,619	1,534	1,570	16,964

This table shows that there have been in the twenty-one years nearly as many deaths in the Eleventh Ward from filth diseases as in the two wards having the next highest number of deaths from these causes; and that more than one-fourth the total number of deaths thus caused occurred in that ward. The total number of deaths in the twenty-one years from filth diseases in the city (exclusive of public institutions) being 14,883, and in the Eleventh ward 4,248. By far the larger part of the built up portion of the city drains into the upper end of Channel street and the streets immediately adjacent. This sewage matter is not carried off by tidal movement, but remains to a great extent in Channel street, and during the dry season in the lower reaches of the larger sewers. In addition to this, from 250 to 275 loads of foul and putrefying garbage are daily dumped in the low lands lying near the center of this ward. There are, therefore, very perceptible causes for the severe mortality above given. It must be observed that where any portion of the city is infected with filth diseases or causes favorable to their production and propagation, other portions, although remote, cannot escape, for in this class belong all of the infectious and contagious diseases. Even

Diagram

showing average monthly rainfall and average monthly rate of deaths from filth (zymotic) diseases in San Francisco from 1872 to 1893.



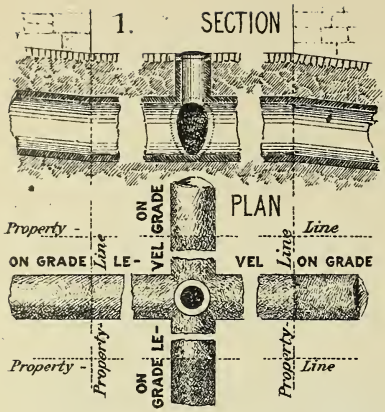


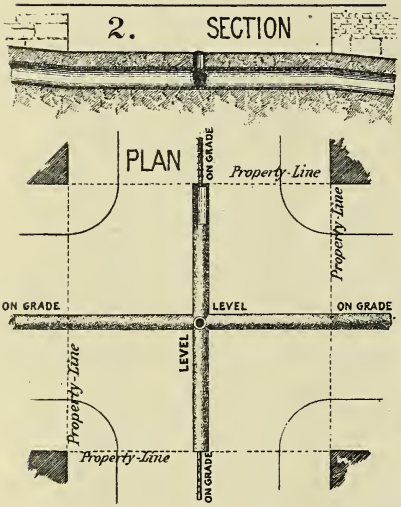
DIAGRAM showing
Types of SEWER-CROSSINGS
as heretofore prescribed.

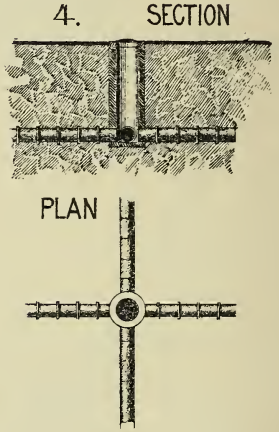
1. *Brick-crossing betw. property-lines, - brick street-sewers.*

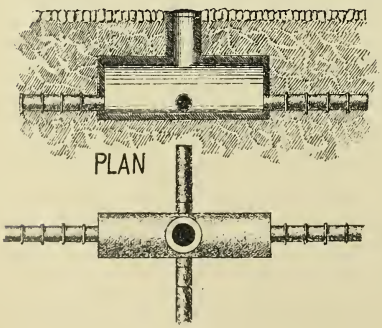
2. *Brick-crossing betw. property-lines, - brick & pipe street-sewers.*

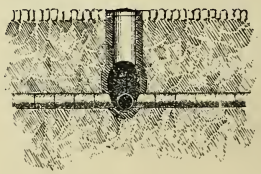
3. *"Bobtail" brick-crossing, - pipe street-sewers.*

4. *Manhole, - pipe street-sewers.*









Scales :

FOR :
1, 3 & 4

2

were the property holders in this large and wealthy ward willing to submit to the present conditions, it is the imperative duty of the city authorities to abate the deadly contaminations now existing within its limits. The prime problem to which our attention is being directed is the interception of the great volume of sewage now reaching this flat region, and its delivery into deep water having strong tidal currents. But before this can be done, much improvement can be made by a proper utilization of Brannan street sewer, and by the adoption of a rational and cleanly system of garbage disposal.

The relation between filth diseases and the incomplete flushing of sewers by rainfall is also marked. It is distinctly noticeable that as the dry season approaches and the condition of the sewers becomes worse by the accumulation of filth, the number of deaths from filth diseases increases. This relation is shown in the accompanying diagram, which shows the mean number of deaths from these diseases and the mean rainfall for each month from January, 1873, to December 1892, inclusive (from 1888 to 1892 the lists include Mongolians).

This study shows that even the flushing possible under the conditions does some good, and it is reasonable to infer that were the sewer system remodeled so as to permit of complete flushing that many of the causes now producing a very high death rate from preventable diseases would be removed.

TABLE SHOWING NUMBER OF DEATHS IN EACH WARD FROM FILTH DISEASES FROM 1872 TO 1893.

YEAR.	1st. NO.	2d. NO.	3d. NO.	4th. NO.	5th. NO.	6th. NO.	7th. NO.	8th. NO.	9th. NO.	10th. NO.	11th. NO.	12th. NO.	TOTAL NUMBER.
1872-3....	34	62	6	38	3	24	35	40	48	99	94	67	550
1873-4....	48	62	8	34	11	24	61	71	71	164	139	88	781
1874-5..	42	60	6	28	8	25	65	57	69	97	115	58	630
1875-6..	46	59	4	45	2	20	72	48	73	116	194	92	771
1876-7...	94	138	18	126	6	41	90	121	169	292	426	180	1,701
1877-8..	47	85	6	45	4	21	48	48	74	135	277	122	912
1878-9....	42	44	3	39	4	21	34	33	42	99	200	85	646
1879-80...	20	33	2	30	4	6	26	29	39	75	130	68	462
1880-1....	27	52	5	20	2	14	23	29	45	88	114	57	476
1881-2....	19	58	8	29	2	17	54	29	45	72	121	86	540
1882-3....	15	40	5	57	5	23	18	20	35	52	141	111	522
1883-4....	25	40	6	44	2	23	17	30	44	69	156	81	537
1884-5	25	61	3	67	1	34	18	47	82	124	167	116	745
1885-6....	16	47	1	33	1	22	25	29	102	60	204	97	636
1886-7....	13	45	3	22	7	24	31	38	88	75	213	120	679
1887-8....	24	42	6	46	7	23	36	42	70	76	214	130	716
1888-9....	28	24	12	37	2	9	17	22	49	74	153	84	511
1889-90...	31	65	6	42	3	13	38	21	31	84	169	106	609
1890-1....	14	58	4	40	5	28	41	51	28	156	387	123	935
1891-2....	25	52	5	43	6	19	47	48	45	103	346	134	873
1892-3....	21	41	3	56	5	9	25	27	32	52	288	92	651
Totals....	656	1168	120	921	90	440	821	879	1281	2162	4248	2097	14,883

To the extracts and comments made in reference to the lack of system in the matter of drainage and sanitation a few general remarks may be added.

With sewage outfalls all around our water front from Pierce street on the north to Islais creek on the south, with Mission flats so fouled with garbage, street sweepings and sewage that no lead paint can withstand the tarnishing effect of the contaminated air to the leeward, with countless filth repositories on or connected with every line of sewers, and with structural defects that entail great annual expense of repair and maintenance, it is not surprising that the necessity for seeking a remedy was at last recognized and resulted in the appointment of a Board of Engineers.

The appointment of the Board of Engineers and later of the Engineers in Charge does not fully accomplish what is so much needed—engineering control and engineering supervision of sewer construction. But while at work devising a sewer system, which duty has been specifically assigned to the Engineers in Charge, they can to any extent desired by the Hon. Board of Supervisors in matters pertinent to their work be requested to serve in the capacity of Advising or Consulting Engineers, and in this way we and the original Board of Engineers have had frequent occasion to serve the city.

During the current fiscal year we had hoped to be permitted to take the initial steps to effect improvements in the interest of better sanitation.

We had hoped that such changes in the apportionment of flow to the various sewers could be made at our suggestion that would prevent the possibility of floods near Howard street from Fourteenth to Eighteenth streets, at Market and Jones and Market and McAllister streets, and at several points in the northern portion of the city.

It was also hoped that before next summer means would be found for carrying out works to divert the entire flow of sewage proper, except during heavy rainstorms, from Channel street to a temporary outfall directly into San Francisco bay. But we fear that the limited funds set aside for these purposes will not be sufficient to fully carry out these much needed modifications.

ORGANIZATION OF THE BOARD OF ENGINEERS.

ITS WORK AND SUBSEQUENT PROCEEDINGS.

The Board of Engineers to Devise and Provide a System of Sewerage was organized under Resolution No. 6612 (Third Series) adopted March 7, 1892.

The proceedings had in the Board of Supervisors which had a bearing upon or led to the creation of the Board of Engineers are set forth in detail in the Appendix to Municipal Reports of 1891-92, pages 214-229.

A special message from the Mayor, Hon. E. B. Pond, dated May 7, 1887, is there cited, which calls attention to the sewers and to the wish of some citizens to have an expert engineer report as to the most feasible plan of putting the sewerage system into good condition. The Mayor's message having been referred to the Street Committee, the necessity for some action was emphasized by that committee, but it had no definite results and the whole matter remained in abeyance.

The Board of Supervisors is empowered by the Consolidation Act and other laws defining its powers, upon the recommendation of the Superintendent of Streets and Highways, to authorize work that may be essential for the safety of life or necessary for the public health, and to set apart money for this purpose in the Street Department Fund.

The Superintendent of Streets and Highways in his official report for the fiscal year 1890-1 made the following recommendations:

"The sewerage question still remains the most important of all questions which concern the public health. The formulation of a general plan adapted to the necessities of the inhabitants and the proper drainage of the city is still unperformed. This work your Honorable Board should attempt in the near future. It is true that many of the outlying districts can be effectually sewered

by special plans or local systems, as has been done in the Point Lobos district, and can be done in all portions of the city and county, outside the charter line of 1851, but the necessity for a general plan, embracing those local systems wherever their outlets come inside the said charter line, is increased and not diminished by their construction. The sewers heretofore constructed in this city reach the waters of the bay through outlets which are all under water at high tide. The sewage matter is thus backed up along the lower levels, creating a nuisance which cannot be abated by any exertion I may make. To remedy this evil, competent engineers should be employed to prepare a plan for sewering the entire city."

On January 25, 1892, after having had the matter under consideration for some time, a report was made by the Street Committee of the Board of Supervisors, in which the history of the several efforts to secure a comprehensive plan was set forth and it was recommended that premiums be offered for complete plans. The offers were to be so liberal that the best engineers in the country would be induced to compete. This committee report is replete with valuable suggestions. It led to the conference of a committee from the Board of Supervisors with Prof. Frank Soulé of the University of California.

The Street Committee made a second report on March 7, 1892 and by unanimous vote at that time the following resolution was passed by the Board of Supervisors:

"Resolution No. 6612 (Third Series.)—Resolved, That Professor George Davidson of the United States Coast and Geodetic Survey, Col. George H. Mendell of the United States Engineers and Irving M. Scott, Esq., be and are hereby empowered to select and appoint two engineers, and when the same are so appointed that they, with the gentleman named, shall constitute a Board of Engineers on and from September 1, 1892, to devise and provide a system of sewerage for this city and county, as proposed in the report of the Committee on Streets, etc., of this Board made January 25, 1892."

On Tuesday, July 21, 1892, the three members named in the above resolution met in the office of the United States Coast and Geodetic Survey, and organized by electing Prof. Davidson President, and Mr. Scott Secretary, and made preliminary arrangements for securing permanent rooms for the transaction of the business of the Board.

On August 8, 1892, the Board again met and notified the Board of Supervisors of their acceptance of the duties imposed upon them by resolution No. 6612, above quoted.

At this meeting the following resolution was adopted:

"Resolved, That Marsden Manson and C. E. Grunsky be appointed as the two civil engineers to complete the Board of Engineers as contemplated by resolution No. 6612, adopted by the Board of Supervisors, March 7, 1892; provided, they agree to devote their entire time to this work after being officially notified by President Davidson."

Subsequent to the passage of resolution No. 6612, the Board of Engineers were authorized to commence operations before the 1st day of September, as intended by the original resolution.

On August 27, 1892, the Board met. The additional members named in the resolution of August 8th attended, filed their letters of acceptance and were declared qualified members of the Board. Final organization of the Board was then made with Prof. Davidson as President, and Mr. Scott as Secretary.

The work outlined and inaugurated for a study of the problems before the Board was as follows:

1st. An examination of the present sewer system of this city for the purpose of ascertaining the condition of the sewers in respect to permanence of construction and serviceability.

2d. The preparation of a complete topographical map of the city and county on the basis of all available data. This map to be upon the scale of 1 inch in 600 feet, showing alignments and elevations of streets, and the detail topographical features expressed in contour lines.

3d. The materials, alignments, depths, sizes, grades and exact conditions of existing sewers to be graphically represented upon large atlas sheets upon a scale of 1 inch in 100 feet.

Although thus promptly organized and prepared to discharge its duties, the Board found legal questions raised as to its status and authority. The Auditor refused to audit bills for services and materials, and these matters had to be passed upon by the District Attorney, who gave an able and exhaustive opinion sustaining the legality of the action of the Supervisors and pointing out the urgent needs which had called forth such action.

It was not, however, until the middle of December, 1892, that the questions and doubts thus raised had been finally settled.

The Board held regular weekly meetings, at which the petitions for changes or establishment of grades, for the construction of sewers, or for the remedying of nuisances, were acted upon; also specially called meetings whenever the matters thus before the Board required prompt action.

There were thus referred to the Board from its organization to February 1, 1893:

Eighteen (18) petitions and protests for changes or establishment of grades.

Three (3) petitions for advice as to the correction of prominent defects in the existing sewer system of the city; besides numerous personal interviews were had and individual letters presented.

During the meeting of February 1, 1893, a certified copy of resolution No. 8265 (Third Series), adopted January 30, 1893, was received from the Clerk of the Board of Supervisors. This resolution is as follows:

"Resolution No. 8265 (Third Series)—RESOLVED, That the services of the Sewerage Commission consisting of Col. G. H. Mendell, Professor Davidson, Irving M. Scott, Marsden Manson and C. E. Grunsky, appointed by the last Board of Supervisors, be dispensed with after the 1st day of February, 1893;

"RESOLVED, That the work of said commission be continued under the supervision of Marsden Manson and such assistants as may be required, under the control and direction of the Committee on Streets and the City and County Surveyor;

"RESOLVED, That the salary of said engineer be fixed at $250.00 per month, commencing February 1st, 1893."

After short discussion the following resolutions were passed:

"RESOLVED, That the services of all persons in the employment of the city under the direction of this Board of Engineers are hereby dispensed with, to date from the close of the first day of February, 1893, and that Mr. Manson be directed to notify them accordingly; and it was further

"RESOLVED, That all books, papers, records, maps, implements, and other property appertaining to this Board, being the property of the city and county of San Francisco, be and are hereby turned over to Mr. Manson as custodian for the city."

The President was authorized to certify all claims for services accruing on February 1st, 1893.

The Board then adjourned sine die.

On February 2d, in pursuance with the duties imposed by the resolutions above quoted, all parties in the employ of the city under direction of the board were discharged, and the following letter was sent to the Board of Supervisors by Mr. Manson:

"I have been instructed by resolution of the Board of Engineers, adopted at their final meeting on January 31st, 1893, to report to your Honorable Board that during the meeting referred to a certified copy of Resolution No. 8265 (Third Series), adopted by your Honorable Board on January 30th, 1893, dispensing with the services of the members of this Board after the first day of February, 1893, and that upon receipt thereof the following resolutions were adopted:

[Resolutions above quoted.]

"At this final meeting Mr. Grunsky reported that all petitions relating to the change of grade and other matters referred to this Board by the Board of Supervisors had been acted on and reported upon, except Resolution No. 8217 (Third Series), referring to the necessity for sewers in the Mission road.

"All accounts against the Board for work, material furnished, and for services rendered by employees were allowed and ordered certified to by your Honorable Board.

"When the meeting adjourned it adjourned sine die.

"In relation to the continuance of this work by me, under the control and direction of the Committee on Streets and the City and County Surveyor, at a salary of $250.00 per month, I desire to state that this proposition is respectfully declined.

"In submitting this record I have also to report that of the $34,450.00 available at the time of the organization, to the close of the first day of February, 1893, $4,117.45 have been expended for services and materials. This expenditure does not include the salaries of the members of the Board, which salaries have not been fixed by your Honorable Board.

"The data in my charge as custodian is not in a condition to be placed on record, but can be put in this condition and be available at any time in the future at an expenditure not exceeding $800.00, exclusive of my services. This data relates principally to the actual condition of the 170 miles of sewers which have been examined as heretofore reported. It is essential at least to put this data in proper form as above outlined."

Appointment of Engineers in Charge.

After several conferences with the members of the Street Committee, the following resolution was passed by the Honorable Board of Supervisors on February 6th, 1893 :

"Resolution No. 8234 (Third Series)—Resolved, That Marsden Manson and C. E. Grunsky be and are hereby appointed (to date from February 1, 1893) as engineers in charge to devise and provide a system of sewerage for this city and county, and to carry on and complete the work of collecting and compiling the data relative to the condition of the present sewers, at a compensation of $275 each per month; the said engineers to report monthly the work done during the preceding month, the cost and other information and estimates as may be required by this Board from time to time, and all other action heretofore had in this matter by this Board relative to appointments is hereby repealed."

The Board was notified on February 11th of the acceptance of the duties above outlined by the engineers named therein, and work was at once resumed on the lines previously laid out.

The following is a summary of the work done from the organization of the Board to July 1, 1893:

The existing sewers, aggregating about 200 miles in length, have been examined and their general condition noted in thirty-two field books. These note books were supplemented by a daily report giving a condensed account of the work accomplished each day. All sewers through which it was possible to pass have been examined as to workmanship and general condition. In some instances where important data could not otherwise be obtained the sewers have been uncovered. The facts thus ascertained are being reduced to tabular form, and 448 sheets of these tables have been made out. The alignments, depths, grades, sizes, materials and condition, etc., are being platted upon atlas sheets on a scale of one inch to one hundred feet. Sixteen of these atlas sheets are complete, ten are in progress, and about forty more will be required to cover the built up areas of the city.

The need of an accurate map showing in detail existing streets and grades, and the exact topographical features of the city and county, led to the projection of a large map, 7x7½ feet, upon a scale of one inch to six hundred feet or 1-7,200. This map has been nearly completed, to the extent that the available data from city surveys and records, from the United States Coast and Geodetic Surveys, from the records and maps of the United States Engineer Department, and from reliable private surveys of all kinds, will permit. Whenever necessary, special surveys were made by this office to connect up isolated surveys, or to remove errors or doubts in the existing data.

This map is intended to serve as a basis for the division of the city into natural sewer or drainage districts, and for a full study of the lines of main drainage.

It was found necessary, in determining the grades of the existing sewers, to run lines of levels through many streets. This was particularly necessary in the portions of the city which have been reclaimed from tidal or marsh lands. Over these areas settlements have occurred since construction, which settlements have aided in making the grades more irregular than originally constructed.

Data as to the area and character of paved and unpaved streets, and the number, position, size and character of storm water inlets ("cesspools") is also necessary in the study of the problems before us. A small party is therefore engaged in collecting this information, and at the same time determining the exact location of all manholes. This data is not available in any records, and will be put in shape to be of permanent record and use in the Street Department.

RECEIPTS AND DISBURSEMENTS FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

RECEIPTS.

Appropriation of July 1, 1892		$35,500 00	
			$35,500 00

DISBURSEMENTS.

By Wm. P. Humphreys, Esq., engineer in charge of collection of data		$1,062 00	
By Board of Engineers to devise and provide sewer system—			
Office work	$4,446 03		
Sewer examination	2,473 72		
		6,919 75	
By Engineers in Charge to devise and provide sewer system—			
Office work	$3,058 23		
Field work	297 00		
Engineers' salaries	2,750 00		
Sewer examination	2,343 83		
M. H. Elevations	736 91		
M. H. Distances	235 65		
Current observations	857 83		
		$10,279 77	
			$18,261 52
Balance on hand			$17,238 48

RECAPITULATION.

Total amount services	$17,082 10
Total amount materials, expenses	1,179 42

Respectfully submitted,

MARSDEN MANSON,
C. E. GRUNSKY,

Engineers in Charge to Devise and Provide Sewer System.

ERRATA.

P. 7—Last paragraph, first, second and third lines, should read, "the lower portions of which are eleven feet wide and eight and one-half feet high."

P. 8—Third line should read: "It is a brick sewer, nine feet wide, seven feet high."

P. 8—Fifth line, omit "Third street."

P. 17—Sixth paragraph, last line, should read, "throughout to Channel street."

P. 30—All of first two paragraphs on this page are quoted.

P. 31—Eighteenth liue should read, "opposition by property holders," instead of "opposition to property holders."

P. 38—Ninth line from bottom, strike out "by."